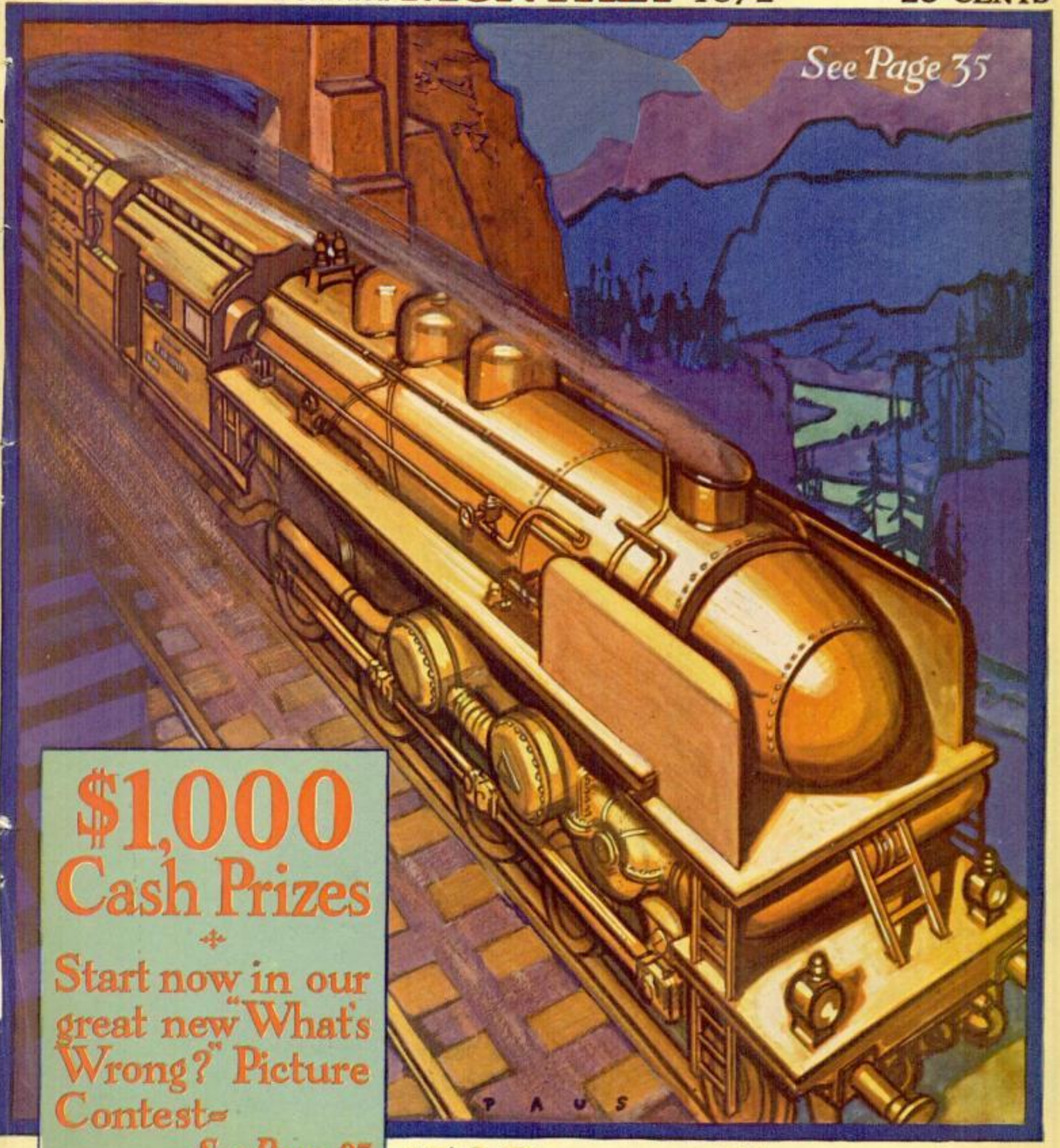
Popular Science

NOVEMBER SM Founded MONTHLY 1872 25 CENTS

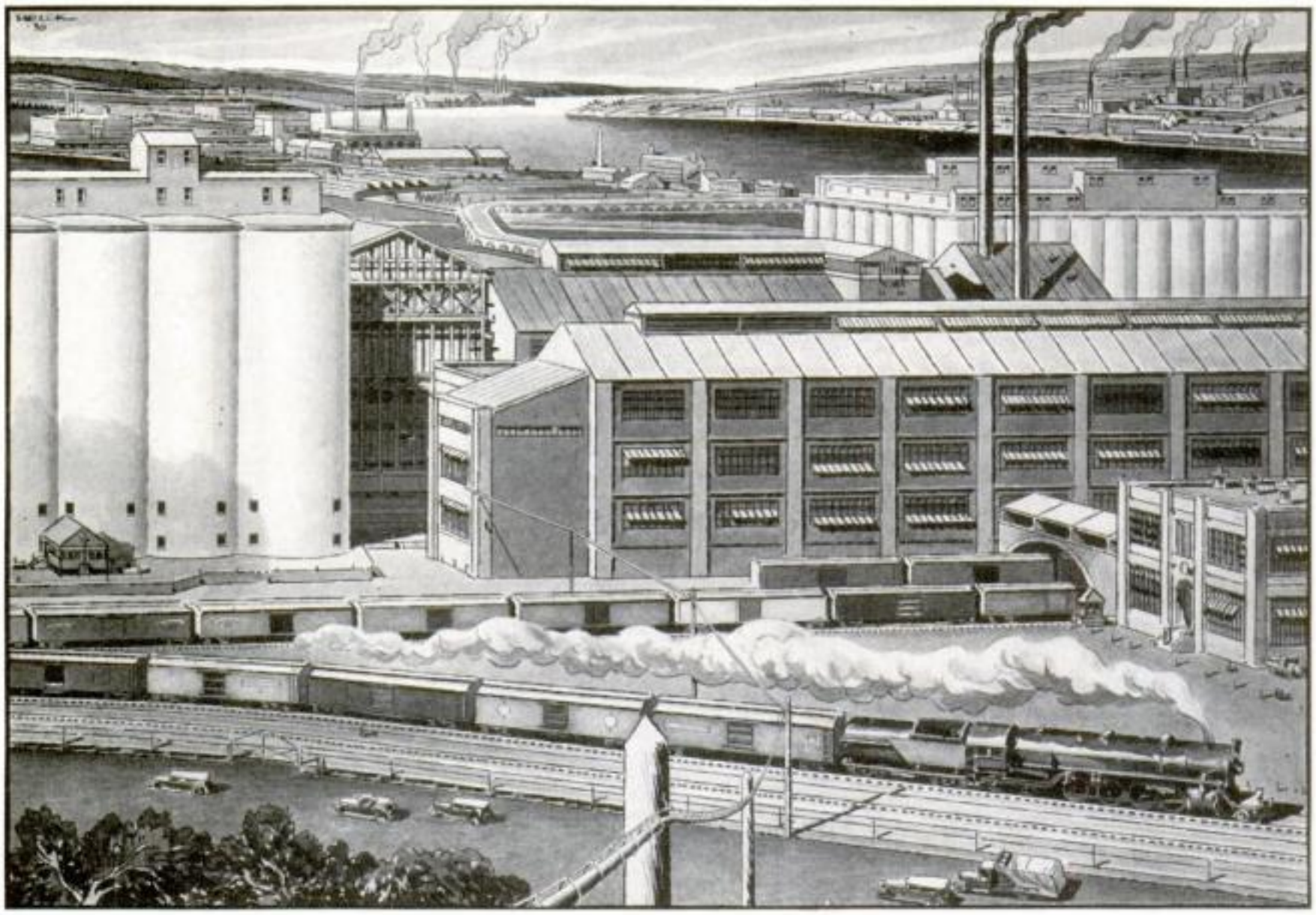


$1,000 Cash Prizes

Start now in our great new "What's Wrong?" Picture Contest—

See Page 27

150 Pictures *Showing the Newest Inventions from All over the World*



Giants out of the earth

An Advertisement of the American Telephone and Telegraph Company

NO AGE but ours has seen so swift and complete an application of natural forces to the doing of daily tasks. Man's leaping knowledge . . . embodied in industrial plants and laboratories, airplanes and electric locomotives . . . has won new power and freedom. Machines are the symbols of a new relationship with nature. They are the servants of this civilization . . . helping men to extend the limits of their opportunities, to change the character of their life.

Americans have been pre-eminent in this change, for in whatever they do they seek to utilize nature to the utmost. They have taken the power out of the earth and from the running streams. They have made it turn the wheels of their industry and move their products by rail and road. They have made color and variety out of chemistry. They have spun metal in slim wires to carry their voices anywhere with the speed of light . . . and make neighbors of the scattered millions of America.

Joining homes and work places, towns and distant cities, the Bell Telephone System has furnished a new communication for this new age. Forwarding the growth of the nation, giving better and more complete service in advance of the demand, its function has become the indispensable one of furnishing the means of social and business contacts in crowded cities and scattered villages over the length and breadth of a continent.

The Bell System is constantly improving the scope, speed and accuracy of its service. Its work of contributing to the welfare and prosperity of American life goes on with increasing purpose and pace.

25 Cents a Copy
$2.50 a Year

Popular Science
MONTHLY Founded 1872

381 Fourth Avenue
New York, N. Y.

Table of Contents for November, 1930

LEADING ARTICLES

FEATURES AND DEPARTMENTS

AUTOMOBILES

AVIATION

ENGINEERING

HEALTH AND HYGIENE

November, 1930, Vol. 117, No. 5. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Chicago, Illinois. Application for entry as second-class matter at Dayton, Ohio, is pending. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Single copy, 25 cents. Nine months' subscription, $2. Yearly subscriptions to United States, its possessions, and Canada, $2.50; foreign countries, $3. O. B. Capen, President and Treasurer; R. C. Wilson, Vice-President; A. L. Cole, Vice-President and Secretary.

Popular Science Monthly for November, 1930

MODELS

NEW PROCESSES AND INVENTIONS

PHOTOGRAPHY

RADIO

SHIPS

UNUSUAL FACTS AND IDEAS

FOR THE HOME OWNER

CRAFTWORK

WOODWORKING

IDEAS FOR THE HANDY MAN

HINTS FOR THE MECHANIC

A Budget That Builds $45,000 On a Moderate Salary

By LEON MEADOW, *Financial Editor*

IT WAS 5:30 and Tom Addison was through for the day. But instead of reaching for his hat and leaving, he remained at his desk, toying with a pencil, day-dreaming. A $500.00 raise for the coming year had started him building air castles. His day-dreaming led him back to present conditions and from there it was but a short step to worry. Fifteen minutes passed, half an hour slipped by, and still he toyed with his pencil, still he sat there worrying. Finally he got up, took his hat and left the plant.

Sylvia was already setting the table when he stepped inside the door. "You're late Tom. Mary's in bed now. Better run upstairs and kiss her goodnight before she's asleep."

"Sorry, dear. I had some work to finish. I'll be ready in a few minutes."

That evening the Mortons dropped in, and Sylvia was soon busy with Agnes at her weekly bridge lesson. After a few minutes of trivial conversation, Tom suggested a walk. Bob Morton liked the idea and presently the two men left the house. They walked along in silence for some time and then Tom unburdened himself.

"Bob, you'd never think that a $500 raise would put a man in the worst sort of a mood, would you?"

"My best, old fellow. Keep up the good work. But why the dejection?"

"Well, it's simply that this raise has brought matters to a head. For a long time I've been worrying about how to lay my plans for the future—how to make both ends meet and still have enough string left for tomorrow and the day after. To me this raise means the beginning. I'll have to start some sort of a systematic savings and investment budget this year. You see, little Mary's five years old now and I've set my heart on seeing her through college—if it's the last thing I do. But how? There are other considerations. My future—Sylvia's future—our needs and all those similar problems. Here I am at 28 with $1,000 in the savings bank and $3,000 worth of insurance. This coming year my salary jumps to almost $75 a week—or to be exact $3,750 for the year—and if I keep my living expenses down to the same $60 a week as I did last year—in all about $3,000 for the year—I'll have $750 surplus—less $50 for insurance—or all of the huge amount of $700 to start my grand scheme. That's a great help!"

Tom continued talking for a long while, outlining his circumstances, hopes and ambitions. Bob Morton said very little. Once in a while he put in a pertinent question or asked for a repetition. Then, after Tom had finished, Morton summed up his problem this way:

"You want to assure Mary of a college education. You have just received a good increase in salary and are reasonably sure of your position at the plant—have hopes for more advancement as the years go on. You should be able to save more each year and you want to be sure you are going to follow the safest, swiftest road to financial security at 50 or so. Tell you what, Tom—let's go back to the house and get out the old pencil and paper. Your case isn't so radically different from mine. Five years ago I worked out an investment plan and so far I've been able to follow it quite closely. Let's you and me get a batch of figures in front of us and do this thing right."

When they returned to the house, their wives were still engrossed in the fine points of bridge. After exchanging a few remarks Bob and his host slipped upstairs to Tom's room and sat down at his small desk.

"Now look—Bob", Morton began—"You're carrying a $3,000 life insurance policy—at a net premium of $50.12—leaving you a balance of $700 saving above all expenses this year. Let's start on Mary's educational fund right away. Only one way to do that, and Building & Loan Shares is the way. Savings become almost compulsory, the desire for withdrawal is minimized and the interest, in a reliable company, will run to about 6%. I'm paying $20 a month on mine, and I will have about $4,000 at the end of twelve years—have the exact figures in my pocket. So let's put down $240 a year for that item, leaving you with $460. Put that in your savings bank—at 4¼% compounded quarterly—now let me see—yes, that brings the total to $1,523.70 at the end of the first year. Then, at 29, you're ready to start on your investment program. Bonds—good bonds, yielding 5½% and more insurance each year—to say, $25,000 total."

Two hours later Bob Morton had finished the entire schedule. Annual salaries and living expenses had been approximated, as had insurance premiums. (The figures in the chart, on page 5, for premiums are closer to the true ones than his first draft).

Bob Morton picked up the chart, and said to his friend. "You started at 28 with $1,000 cash and a $3,000 insurance policy. If you are able to follow this plan, at 39 your Building & Loan Shares will send Mary through college. Ten years later, at 49, you will have almost $3,000 in the savings bank, $25,000 worth of life insurance and $36,500 in 5½% bonds—your income alone, outside of your business, will be $2,000 a year.

"It all goes to show you that interest can be your friend if you put it to work. Look at the chart. At 29 you have $1,523.70 in the savings bank and a $750 saving for the year. $240 goes to Building & Loan, $85 to insurance, now that you've taken out an additional $2,000 policy. That leaves you *(Continued on page 6)*

A Budget That Builds $45,000 On A Moderate Salary

(Continued from page 4)

with $425. We've taken a flying start and bought a $1,000 bond, which necessitated drawing $675 out of the bank—yet you still have close to a $1,000 left. The next year is even more interesting. Insurance premiums have been raised by another $2,000 policy to $120. But that year you figured on a raise and a surplus of $1,000—so that after $240 has been subtracted for Building and Loan—you still have $640 left. We wanted to bolster the bank account that year and so we contented ourselves with a $500 bond and $140 into the savings bank. Yet, the account jumped over $350 that year. Why? Because you received $55 interest from you $1,000 bond, put it in the bank and drew interest on $1,138 all together.

"When you come down to the later years, this business of interest reinvested to draw more interest assumes even greater proportions. Take your 45th year—from your $1,000 bond, put it in the bank In the 46th year, your annual surplus is $2,000—subtracting $435 for premium on $25,000 worth of insurance, you have $1,535 left. You withdraw $1,465 from the bank and buy $3,000 worth of bonds. That leaves you with a deposit of about $850. Yet, at the end of the 46th year, your bank balance actually is $2290.57. Why? Because that year you received $1,320 income on your bond investments—put it in the bank and let it draw interest along with that $850. Great stuff, I call it!

"Remember, the plan has been worked out on the assumption of a total increase in salary of $4,250 in 22 years—or close to $200 annual raise, which I think is about normal and not impossible to accomplish. On the other hand, if you don't make the grade on any given year, it's up to you to readjust your expense scale to keep the same ratio as the chart calls for. In that way you will conform to your budget and not be tempted to cut down on investments—or draw too much on your cash reserve. Then again you may have the good fortune to rise very quickly and find yourself with more money on your hands than you anticipated. If so, try to beat the figures on the chart. You'll be thankful for doing so in your later years. At all odds—the big point is not so much your ability to check in actual dollars the theoretical terms of the budget, as it is to abide by the principle of the thing—to always reinvest your accruing interest on bonds and savings deposits.

"To summarize, Tom—at 28 you're worth $1,000—the cash value on $3,000 life policy, running for two years, is negligible. If anything should happen to you, you leave an estate of $4,000 behind you. At 49—you're worth in cash—$45,000—figuring about $5,500 cash value on your policies. But your estate—should you be called to your maker—is worth $65,000—and that would bring Sylvia and Mary an annual income of close to $4,000."

Bob studied the chart for a long time, shaking his head in amazement. "I can't believe it, Bob—can't believe it's possible to accumulate so much money. Where's the hitch?" *(Continued on page 7)*

Age	Salary	Surplus Above Living Expenses	Accruing Investments			Annual Investment Payments			Savings @ 4¼ % Comp. Quart.	
			Insurance	Bonds	Building & Loan	Insurance Premiums	Bond Purchases	Building & Loan	Annual Deposit (+) or Withdrawal (—)	Balance Including Deposit of Bond Interest
28	$3750	$750	$3,000		$240	$50.12		$240	+$460	$1523.70*
29	3750	750	5,000	$1,000	501.96	81.69	$1000	240	— 675	948.70
30	4000	1000	7,000	1,500	772.08	119.83	500	240	+ 140	1299.67
31	4000	750	9,000	2,000	1058.40	155.52	500	240	— 125	1307.72
32	4000	750	11,000	2,500	1375.38	193.34	500	240	— 180	1288.21
33	4250	1000	13,000	3,000	1702.68	228.51	500	240	+ 30	1521.21
34	4250	1000	15,000	4,000	2049.90	268.10	1000	240	— 510	1229.13
35	4250	1000	17,000	4,500	2418.24	306.84	500	240	— 45	1467.31
36	5000	1500	19,000	5,500	2809.08	347.14	1000	240	— 90	1697.92
37	5000	1500	21,000	7,000	3223.68	387.52	1500	240	— 625	1436.31
38	5000	1500	23,000	8,000	3663.54	430.81	1000	240	— 170	1621.11
39	6000	2000	25,000	10,000	4130.16**	474.32	2000	240	— 715	1406.67
40	6000	2000		11,500		451.69	1500		+ 30	2096.98
41	6000	2000		14,000		449.23	2500		— 950	1859.47
42	6000	2000		16,000		446.64	2000		— 445	2282.76
43	6000	2000		19,000		442.72	3000		—1450	1789.83
44	7000	2000		21,000		438.69	2000		— 445	2497.38
45	7000	2000		24,000		434.43	3000		—1440	2311.94
46	7500	2000		27,000		430.21	3000		—1465 *	2290.57
47	7500	2000		30,000		425.68	3000		—1430	2451.10
48	7500	2000		33,000		420.72	3000		—1425	2786.57
49	8000	2000		36,500		415.57	3500		—1920	2801.65
Summary			Insurance $25,000	Bonds $36,500	Mary's College Education					Bank $2801.65

*Includes previous balance of $1000.

**Withdrawn for Mary's education.

A Budget That Builds $45,000 On a Moderate Salary

(Continued from page 6)

Bob laughed. "There is none—unless it be your ability to stick by your guns to the end. It's the old, old story of "dog eat dog"—only in this case you get somewhere. Interest from bonds goes into savings bank to draw more interest to buy more bonds—and so on as long as you adhere to the plan you lay down in the beginning. So many people take the income on their securities and fritter it away on something that catches their fancy at the moment. It looks like found money to them—and they let it go as easily as it comes. But, if you can make it a rule to reinvest all interest—you can swing this thing all right, considering that everything else runs to normal form."

Tom lit a cigarette. "I check with you," he replied, "on every point. You certainly have pulled me through a bad spot, Bob. I don't know that I can thank you enough. But I do hope to kill two birds with one stone—that is, show my gratitude to you and do myself and family the greatest service I can by saving this budget and trying my mightiest to live up to its terms."

To Help You Get Ahead

THE Booklet listed below will help every family in laying out a financial plan. They will be sent on request.

Your Income and Your Life Insurance is the name of a brief booklet scientifically answering the question "How much life insurance does a man really need?" Provident Mutual Life Insurance Company of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

INDEX
Guaranteed Advertisements

Automobiles and Accessories

Aviation

Books

Building Materials

Business Opportunities

General

Hardware Supplies

Industrial Equipment

Investments

Miscellaneous

Musical Instruments

Patent Attorneys

Radio Apparatus

Razors, Toilet Articles, Etc.

Popular Science GUARANTEE

Ⓢ

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use.

Tools, Radio Apparatus, Oil Burners and Refrigerators advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

However, other products advertised in the magazine not subject to test carry the same guarantee to readers as products tested.

THE PUBLISHERS

Schools

Smoking Materials

Sporting Goods and Toys

Things to Make

Tools and Shop Equipment

Typewriters, Writing Materials, Etc.

The WONDER of TELEVISION

The dream of television is being realized! Daily television programs are NOW being broadcast! Receiving sets are now on the market which permit you to *see* as well as *hear!* General public use is predicted within three years! And this is but one of the miracles of modern science that are transforming our lives. No ordinary reference work can give you all the world's information in this age of amazing progress. NELSON'S *does* meet your needs because it is bound in the Loose-Leaf plan—*therefore*—

NELSON'S Keeps Pace With Modern SCIENCE

When a Lindbergh or a Zeppelin flies the Atlantic; a great flood sweeps the Mississippi Valley; a new treaty for world peace is made—when Medicine triumphs over previously incurable disease; or electrical energy performs new miracles—as oil heating for homes is perfected—*always* the FIRST permanent work of reference to fully record it in its proper alphabetical order is NELSON'S Perpetual Loose-Leaf Encyclopaedia.

The information which is obsolete is worse than none at all. You do not use a City Directory that is two years old. Why use an Encyclopaedia that is five or ten years old?

The Encyclopaedia for a Life Time

NELSON'S covers *every field of knowledge* from the dawn of the world to the present day. The *New York Times* says:—"By a novel binding device NELSON'S ENCYCLOPAEDIA solves problems of perpetual freshness. A book that never grows old, that will give answers years after its publication to the most modern queries."

New Pages Every Six Months

Every six months new pages (250 or more) are sent to every subscriber to take the place of out-of-date ones which may be replaced quickly and easily through the simplicity of NELSON'S patented loose-leaf device.

The New Complete Index Volume presenting about 200,000 references makes immediately available every item relating to any subject, no matter how remote.

The Great AMERICAN Encyclopaedia

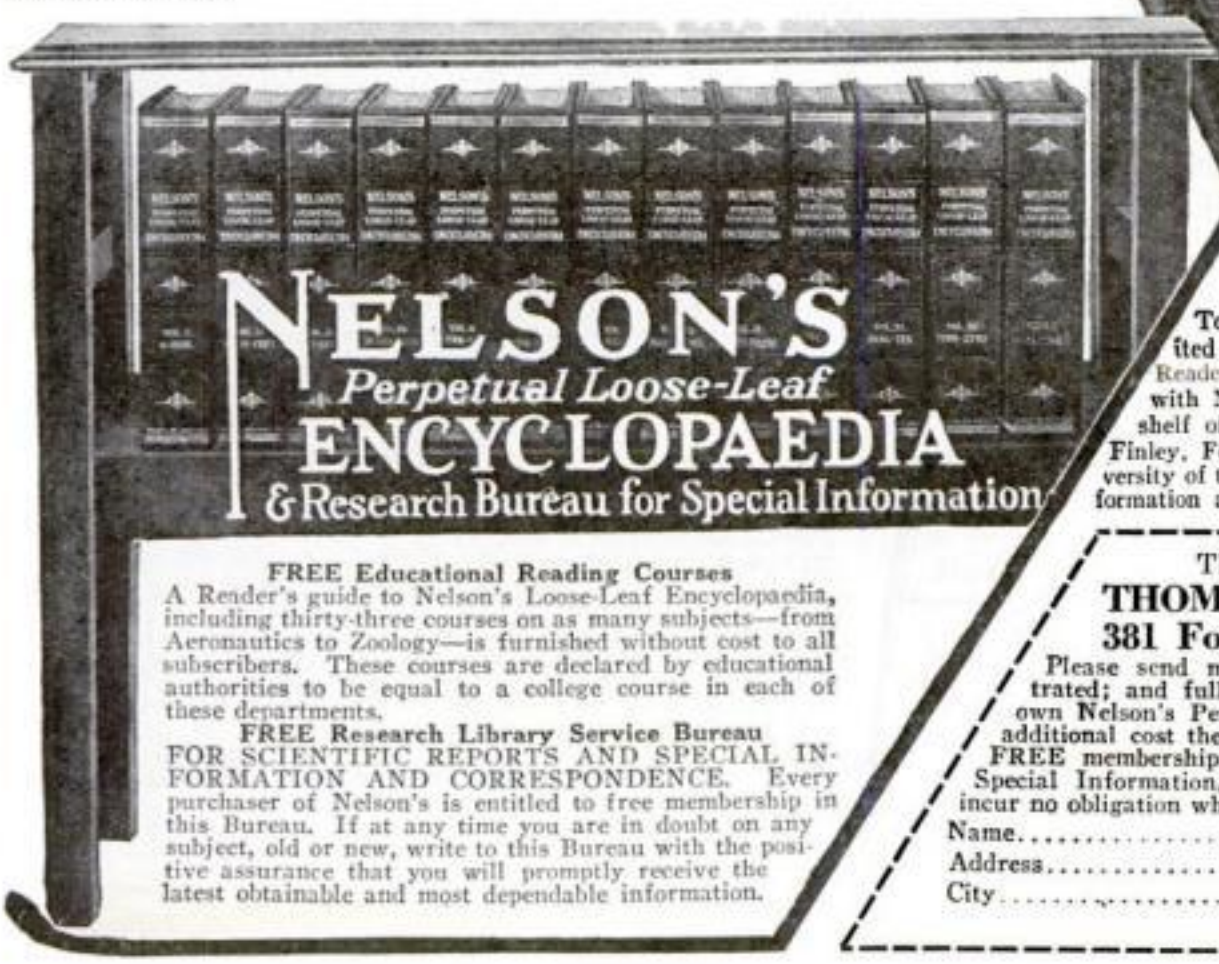
More than 1200 of the greatest scientists, educators, experts and writers in all parts of the globe, who are authorities or actual eye-witnesses of the subjects upon which they write, are constantly engaged in keeping Nelson's Perpetual Loose-Leaf Encyclopaedia fresh and new. They are under the direction of such authorities as John H. Finley, LL.D., Former Commissioner of Education and President of the University of the State of New York; Sir Robert Falconer K.G.M.G., D. Litt., LL.D., President of the University of Toronto, Canada; and Sir John Henry Newbolt, LL.D., Litt., Edinburgh, Scotland.

FREE

A $25.00 Library of the World's Greatest Classics

These are imported volumes. Bound in soft flexible full real leather.

To introduce these luxurious volumes in the United States, a limited number of sets will be distributed Free to early subscribers. Readers of POPULAR SCIENCE MONTHLY who act quickly, can secure, with Nelson's Loose-Leaf Encyclopaedia, a beautiful fifteen-volume shelf of the world's greatest masterpieces, selected by Dr. John H. Finley, Former Commissioner of Education, and President of the University of the State of New York. Use the coupon below NOW for full information about this present special offer to POPULAR SCIENCE readers.



FREE Educational Reading Courses

A Reader's guide to Nelson's Loose-Leaf Encyclopaedia, including thirty-three courses on as many subjects—from Aeronautics to Zoology—is furnished without cost to all subscribers. These courses are declared by educational authorities to be equal to a college course in each of these departments.

FREE Research Library Service Bureau

FOR SCIENTIFIC REPORTS AND SPECIAL INFORMATION AND CORRESPONDENCE. Every purchaser of Nelson's is entitled to free membership in this Bureau. If at any time you are in doubt on any subject, old or new, write to this Bureau with the positive assurance that you will promptly receive the latest obtainable and most dependable information.

This coupon for ADULTS ONLY

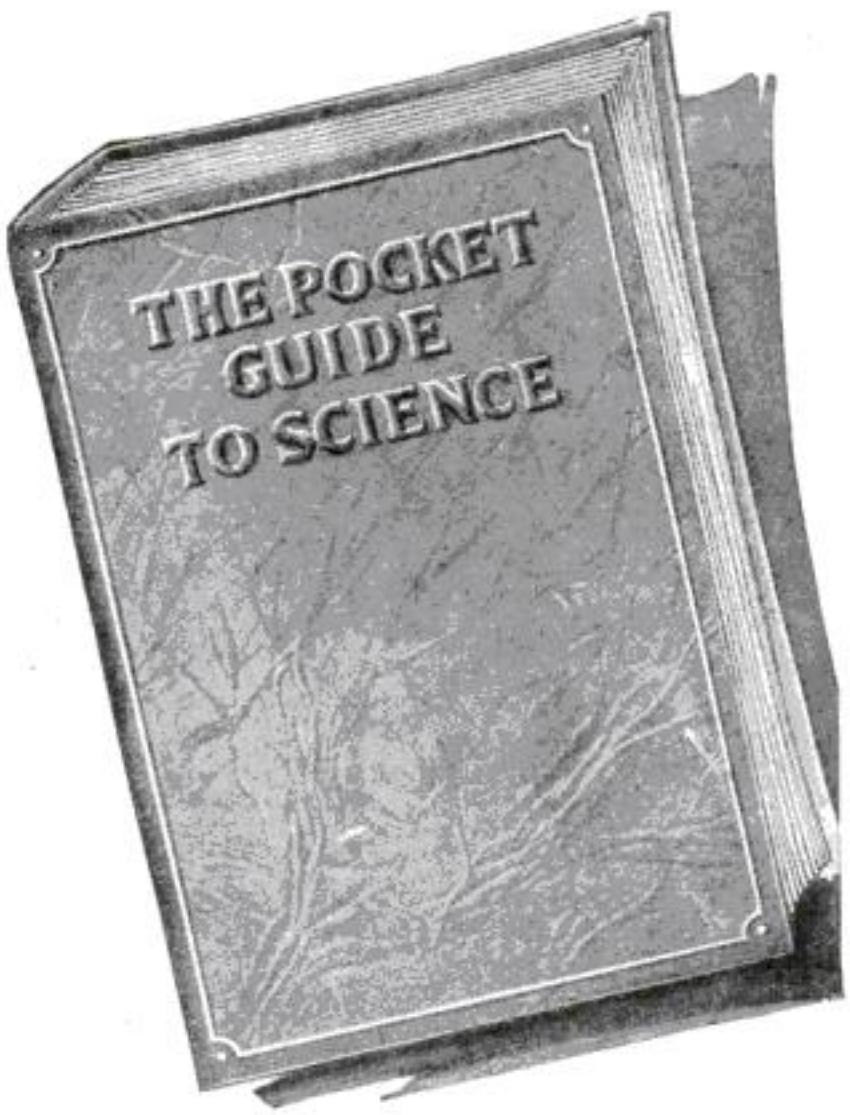
THOMAS NELSON & SONS,
381 Fourth Avenue, New York, N. Y.

Please send me your portfolio of sample pages, beautifully illustrated; and full information how, by easy monthly payments, I can own Nelson's Perpetual Loose-Leaf Encyclopaedia, and obtain without additional cost the $25.00 Library of the World's Great Classics; with FREE membership in Nelson's Research Library Service Bureau for Special Information, and Nelson's Reader's Guide FREE. This must incur no obligation whatever on my part. P. S. M. 11-30

Name.....

Address.....

City..... State.....



INTO THIS one brilliant book of 280 pages have been condensed the outstanding facts that scientists have discovered since Aristotle, the father of science, dissected a frog to see what made its heart beat.

How often have you wanted to know about the wonderful discoveries in science that have so changed the world we live in . . . the secret of radium . . . the romance of the atom . . . the origin of the earth!

Or you may have wanted to know why glass is transparent . . . how fireflies produce light . . . why the grass is green . . . if radio waves move in a straight line?

All of these questions, and hundreds of others, have now been answered, for the first time, in one book—THE POCKET GUIDE TO SCIENCE.

All that you probably will ever want to know about science is told in this one book that will fit in your pocket or grace a library table. The curiosity-satisfying facts about the world we live in are made instantly available to you in simple question-and-answer form in THE POCKET GUIDE TO SCIENCE.

Your Name in Gold
—on this Wonderful Book

YOU are assured of the accuracy of the answers in THE POCKET GUIDE TO SCIENCE because it has been edited by Dr. E. E. Free, the distinguished author of "The Story of Man and His World." Dr. Free has a remarkable genius for condensing the known facts about scientific questions into vivid, easily remembered paragraphs.

SPECIAL OFFER

THE POCKET GUIDE TO SCIENCE is not for sale. It is offered to you *without one penny extra cost*, with a 14 months' subscription to POPULAR SCIENCE MONTHLY.

In THE POCKET GUIDE TO SCIENCE you get full information of all that the scientists have discovered up to the summer of 1924.

POPULAR SCIENCE MONTHLY "carries on" where THE POCKET GUIDE TO SCIENCE leaves off. The POCKET GUIDE gives you all the information up to right now—POPULAR SCIENCE MONTHLY will give you all the important, interesting and new discoveries of science for the next 14 months.

In every issue of POPULAR SCIENCE MONTHLY are a dozen or more important articles that explain and picture the most fascinating and significant new developments, discoveries, and undertakings in exploration, in engineering, in health, in electricity, in medicine, and in every branch of science.

And there are also, in every issue, a hundred or more articles describing the important new inventions in every branch of mechanical activity—page after page filled with photographs and descriptions that show you how you can save money in the shop, around your car, in your store, office and home.

But all this is only part of the contents of one issue of the amazing POPULAR SCIENCE MONTHLY. It takes over 300 articles and pictures every month to tell the readers of POPULAR SCIENCE MONTHLY all that has happened in the scientific, radio, mechanical, and automotive fields.

A Few of the Hundreds of Questions Answered in the POCKET GUIDE TO SCIENCE

Why does static interfere with radio messages?
What gland makes people grow tall or keeps them short?
Why do we grow old?
What is the safest stimulant?
What is the function of the liver?
Why are tears salt?
Can energy be destroyed?
Why can't you skate on glass if it is smoother than ice?
How do self-winding clocks work?
Why does an iron ship float?
Can we see atoms with a microscope?
What are electrons?
Is electricity a form of matter?
What is a crystal?
How large is the universe?
Why do the stars twinkle?
How do we know what the stars are made of?
Is the inside of the earth molten?
What is an electric spark?
What makes the noise of thunder?

Your Name in Gold

We will stamp your name in 22-carat gold on the cover of THE POCKET GUIDE TO SCIENCE *at no extra cost to you* if you use the coupon below immediately.

You are offered a 14 months' subscription to POPULAR SCIENCE MONTHLY (regular price if bought by the month would be $3.50) with THE POCKET GUIDE TO SCIENCE—all for $2.95, plus the few cents' postage. If you are already a subscriber to POPULAR SCIENCE MONTHLY we will be glad to extend your subscription 14 months if you accept this offer.

In using the coupon please PRINT your name

POPULAR SCIENCE MONTHLY, 381 Fourth Ave., New York

SEND NO MONEY

Send no money, just the coupon. If within 10 days after you receive the book and magazine you decide that you are not satisfied in every particular you may return them and your entire payment will be refunded promptly and without question. Could any offer be fairer?

POPULAR SCIENCE MONTHLY
381 Fourth Avenue, New York

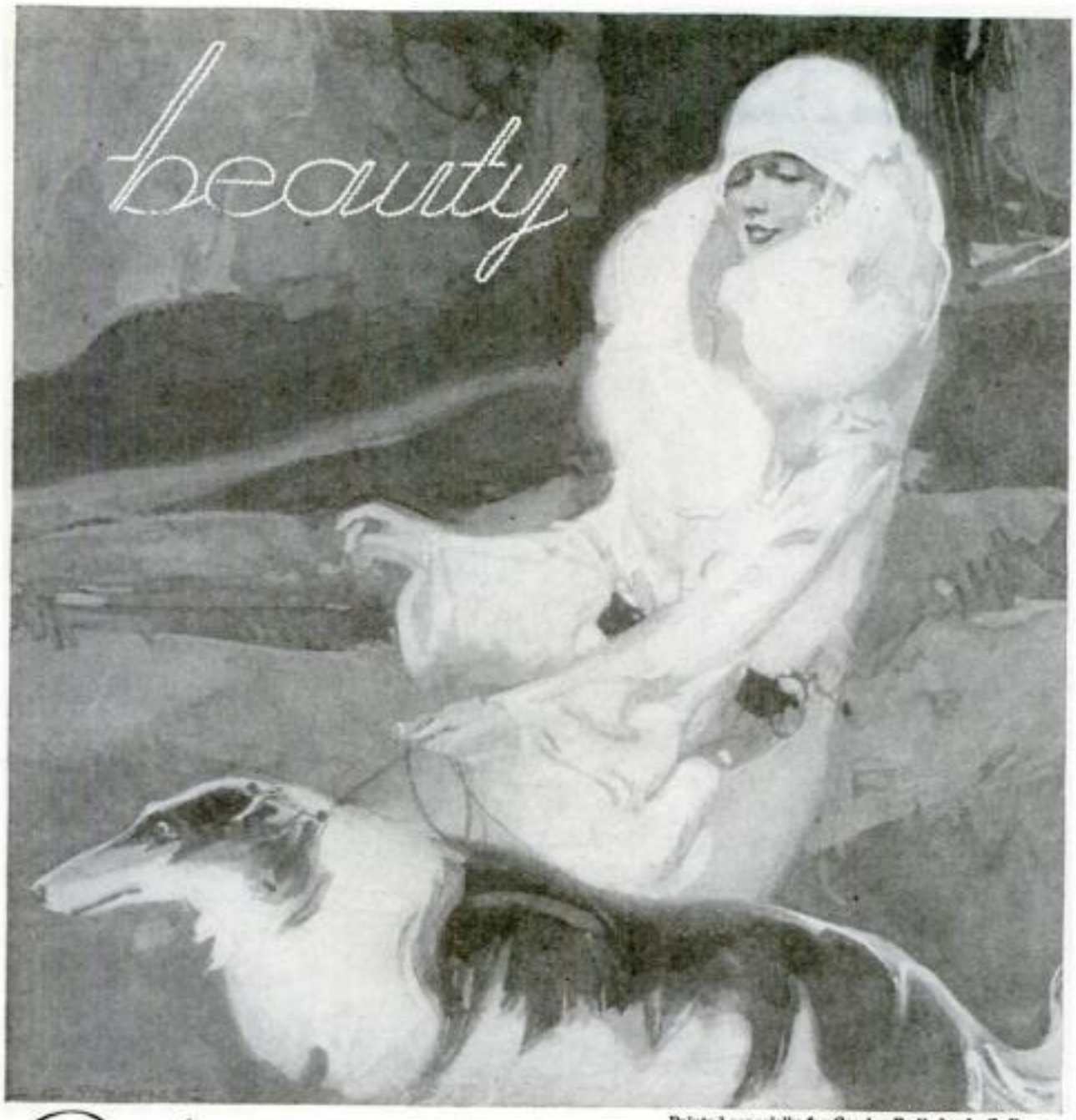
I accept your offer of THE POCKET GUIDE TO SCIENCE and a 14 months' subscription to POPULAR SCIENCE MONTHLY. I will pay the postman $2.95, plus the few cents' postage when he delivers the POCKET GUIDE and the first issue of POPULAR SCIENCE MONTHLY. If the book and magazine are not fully satisfactory to me I will return them within 10 days and you are to promptly refund my full payment. Please stamp my name in gold.

*Name*_____

*Address*_____

*City*_____ *State*_____

11-30



Painted especially for Crosley Radio by A. C. Pearce

You're there with a CROSLEY

Ⓢ

Electric Phonograph and Radio Combination

The Arbiter

A truly versatile instrument that provides complete entertainment for any occasion in the modern home. Soft, crooning music from the air as a background for conversation . . . then some one says, «Let's dance!» Instantly the radio receiver is switched to the electric phonograph and the latest dance hits. The CROSLEY ARBITER livens up your parties . . . . makes your home the center of social attraction for the youngsters and their elders. A cabinet of superlative beauty, a super-selective and sensitive radio receiving set, a power speaker of utmost tone flexibility, Screen Grid tubes, Neutrodyne circuit, A. C. electric, electric phonograph . . . . . all these are yours in the new CROSLEY ARBITER for only . . . . . $137.50 LESS TUBES

Also available with induction type self-starting motor at $147.50

BEAUTY . . . golden autumn and Nature in a new party dress, foot-free in the meadows and the wooded places. "The most beautiful time of the year," poets and idealists venture to say. Perhaps they sense the *living* moods of the seasons . . . the buoyant voices of Spring . . . the chattering comic opera notes of summer . . . Autumn's medley of pathos in a minor key. For the world, at best, is a vast radio in itself . . . alive, vibrant, many-sided.

RADIO . . . to encompass this in a cabinet of beautiful carving . . . to enshrine in a miracle of mechanism the voice of the universe, accessible to finger tips at a moment's notice . . . to follow the seasons through, day in and night out, reflecting their infinite beauty and their gayer moods, requires genius of the highest order. The culmination of this genius is to be found in the new Crosley radio receiving sets . . . opening a new vista in radio cabinet design and construction . . . fair to the eye, physically, and obedient to the individual demands of the human ear in their amazing ability "to get anything on the air," note for note, heartbeat for heartbeat, with the original as it enters the microphone . . . thus is brought you a new day in radio reception by Crosley.

THE CROSLEY RADIO CORPORATION
Powel Crosley, Jr., Pres. Home of "the Nation's Station"—WLW
CINCINNATI

Also manufacturers of CROSLEY *Battery Radio Receiving Sets, the* CROSLEY ROAMIO *Automobile Radio Receiving Set, and the famous* AMRAD RADIO

CROSLEY RADIO

The CROSLEY NEW Companionship Series

SCREEN GRID · NEUTRODYNE
POWER SPEAKER · A. C. ELECTRIC

The NEW Buddy

An exquisite table, mantel or clock type self-contained receiving set, with power speaker, only 15⅜" high, 15⅝" wide, and 9¾" deep, so small in size and light in weight that it is easily moved from place to place. Contains the same type receiving set as The PAL and The MATE. Employs three Screen Grid tubes. Nothing ever equalled it at so low a price . . . . . $64.50 WITH TUBES

The Pal

A marvelously beautiful cabinet, 25⅝ inches high, suitable for use as an end, bedside or occasional table. Contains the same receiving set and power speaker as The MATE and employs same number and type of tubes. The price is amazingly low for the quality and performance $69.50 LESS TUBES

The Mate

A delightfully designed and executed cabinet that harmonizes with any surroundings in the home. It contains an entirely new receiving set and power speaker. Employs three type -24 Screen Grid tubes, one type -45, and one type -80. The unusual value of The MATE at the exceptionally low price is self-evident . . . . . $75.00 LESS TUBES

The CROSLEY NEW Leadership Series

SCREEN GRID · NEUTRODYNE
POWER SPEAKER · A. C. ELECTRIC

The Director

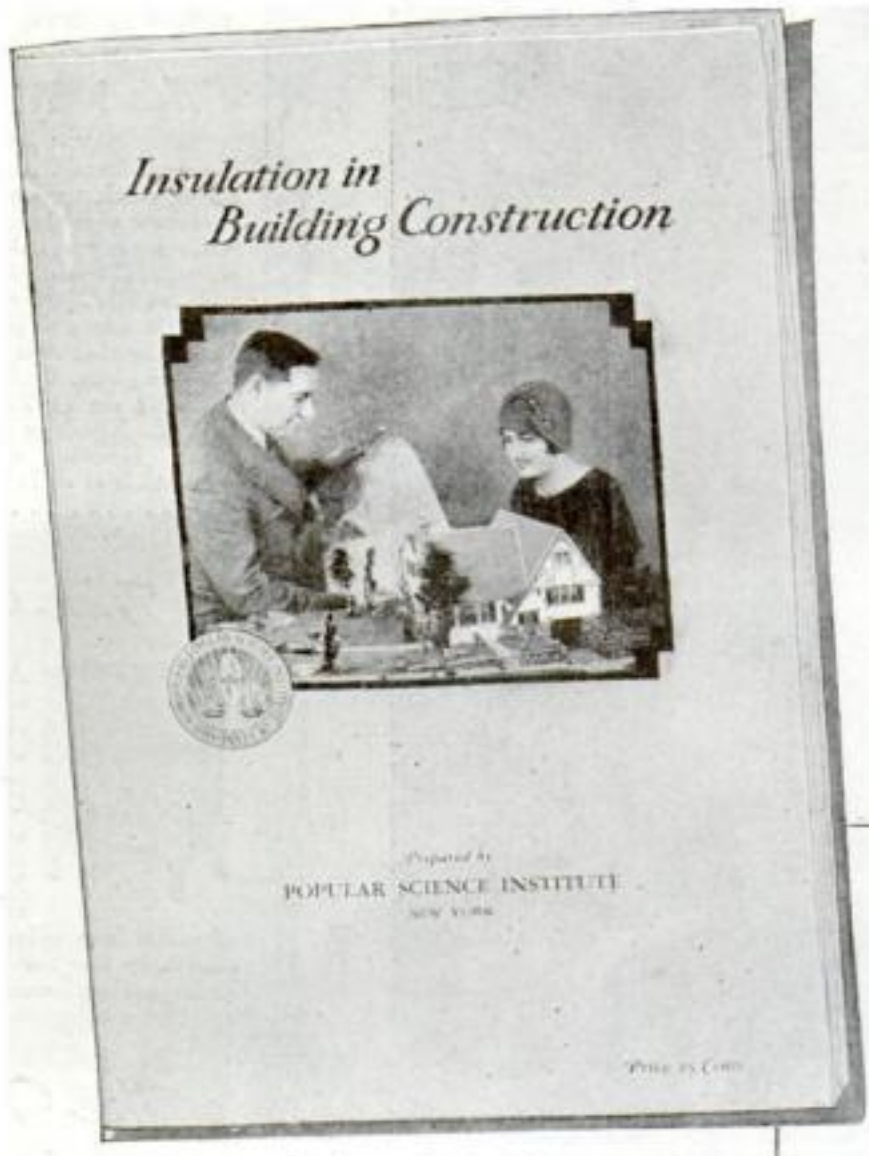
A particularly beautiful cabinet containing a receiving set employing three Screen Grid tubes type -24, one type -27, two type -45, and one type -80. Positive automatic volume control, local-distance switch and dynamic-power speaker are features of this set. Astonishingly low in price . . . . $107.50 LESS TUBES

Available for D. C. at same price

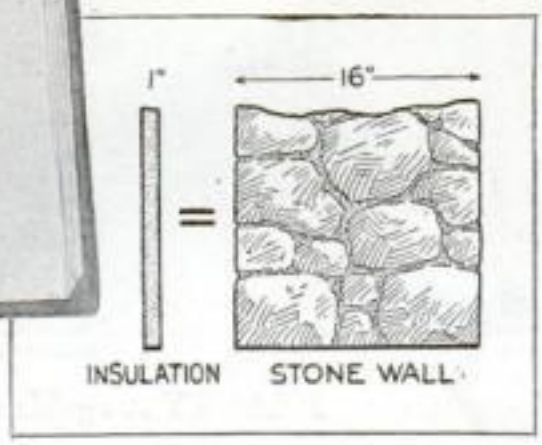
The CROSLEY ARBITER *Electric Phonograph and Radio combination is a member of The* CROSLEY NEW *Leadership Series*

Ⓢ This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

How to Keep Your House Warm



A stone wall sixteen inches thick will not stop the heat loss as effectively as just one inch or less of a good insulating material.



By F. G. PRYOR

Secretary, Popular Science Institute

MUCH is heard these days about "insulated houses," but many people who buy or build what they think is an insulated house are not getting insulation and cannot expect the warmth and economy that go with this worth while feature of modern house construction.

Since insulation is one of the few modern conveniences that is permanent, has no upkeep cost, and pays actual dividends in fuel-saving, it deserves some thought and investigation on the part of the prospective home owner. A house that is not insulated, no matter how substantially built, will allow heat to leak through at a great rate compared to the house that is insulated. In these days of expensive fuel, no one wants to heat a good part of outdoors along with his home.

Heat readily flows through all the commonly used building materials, such as stone, concrete, tile, brick, stucco, slate, lumber, etc., in the thickness ordinarily used. If such materials were used in greater thickness, the heat flow would be proportionately lower, but considerations of expense, space, and weight prohibit the use of extreme thickness in construction, particularly when a scant lining of good insulating material lessens heat loss to an equal extent.

Authorities are agreed that from one half to one inch of any of the several good insulating materials on the market in sheet or quilt form is about equal to an eight-inch outside wall frame or fifteen-inch masonry. The reason for this is that the good commercial insulating materials consist of a mass of millions of tiny dead air cells which slow up heat passage, while regular building materials are comparatively solid in construction and contain few of these air cells.

In this connection, it is an interesting fact that wood is more effective in slowing up heat flow than any other of the ordinary building materials, due to the fact that it has more air cells than most. That is, among uninsulated houses, a frame house, with siding, paper sheathing, lath, and plaster, will be cooler in summer and warmer in winter than one of brick. Insulation would vastly improve either, however.

INSULATION NOT NEW

WHILE it is only in the last fifteen years or so that the word "insulation" has been mentioned in connection with house construction, crude attempts to supply insulation to dwellings are older than written history. Man, not being endowed with self-insulation like animals and birds with their fur and feathers (full of the tiny air cells that stop heat passage), from earliest days has faced the problem of constructing a shelter that would keep him comfortable. His first achievement in this line, the cave, together with later shelters in the form of tents made of animal skins and huts constructed of mud, were all early applications of the age-old principle of heat insulation.

More recently, our great-grandfathers achieved a certain degree of insulation with their walls of stone some sixteen inches thick. Likewise it has been known for centuries that straw is warm, and thatched roofs are still in use in parts of Europe. Pioneer New Englanders took advantage of the insulating properties of this material in filling the hollow walls of their log cabins with grass and straw bound together with mud; while today, throughout the great wheat plains of the western part of our country, the straw shed as a shelter for stock is a familiar sight.

WHAT INSULATION DOES

TODAY, in using one of the standard commercial insulating materials in recommended thickness in the roof and walls of a house, it is possible to bring down fuel costs about one third, permit the use of a considerably smaller heating system, afford uniform room temperature with elimination of drafts, and keep upstairs rooms ten to fifteen degrees cooler than outside temperature in summer.

All this is possible with a really insulated house, but the important thing is to make sure that one is getting insulation in the full sense of the word and not to believe that because the house construction includes an air space, building paper, or back plaster, that it is insulated. Some contractors and builders who are not up on modern methods will put an air space and a couple of thicknesses of building paper in a house and honestly believe they are turning out an insulated dwelling.

Building paper has a definite place in good house construction, but it cannot do the work of a regular insulating material, one half inch of many of the insulators on the market being as effective in stopping heat leakage as ninety-five layers of building paper. What building paper does is to cut down *air* leakage, while an insulator cuts down *heat* leakage. Back plaster is another material that used to be considered a good insulator, but the way in which this really served was as a wind stopper. Everyone knows that wearing a "wind breaker" will only give half protection and something woolen—wool with its many air cells being an insulator—must be worn underneath to keep the heat of the body from leaking through and leaving one cold.

Full information on house insulation will be found in a twenty-four-page booklet prepared by the engineers of POPULAR SCIENCE INSTITUTE entitled "Insulation in Building Construction." Send twenty-five cents to POPULAR SCIENCE INSTITUTE, 381 Fourth Ave., New York.

Rid *your* home of these discomforts—*Now*

Why let winter chill your home and levy "fuel bill tribute" on the family budget? Building new or modernizing now, Masonite Structural Insulation in roof and walls will make your home quiet, snug and warm; will cut your fuel bill substantially, and will protect you from spring's dampness and summer's heat.

Masonite homes cost very little more than those of ordinary construction, for the big sturdy boards both build and insulate. Masonite replaces other materials, is moderate in price, and gives homes such added sale, rental and loan values that Masonite itself becomes a real, dividend-paying investment.

For plastered surfaces that are permanently beautiful, and highly resistant to cracking, there is nothing like Masonite Insulating Lath. Its smooth, even surface prevents the formation of dust streaks on ceilings. Its tough wood fibres hold plaster with a bond of 1,000 pounds or more per square foot. Its millions of dead air cells guard each room from temperature extremes and deaden sound.

Home mechanics use Masonite for partitioning off extra rooms in cellar or attic. Your lumber dealer can supply you with it; carpenters can quickly apply it in either new buildings or old. Masonite booklet, detailing its uses, is sent Free to anyone interested in building or remodeling. Your copy will be mailed on receipt of the coupon.

MASONITE CORPORATION, 111 W. Washington St., Chicago, Illinois

Masonite

STRUCTURAL INSULATION • INSULATING LATH
PRESDWOOD • QUARTRBOARD

Masonite Presdwood — *grainless wood which takes any finish*

Here is a remarkable material which takes any finish so beautifully that even experts often mistake a cabinet of Masonite Presdwood for one of natural wood. This grainless wood is used in the home and the factory for its beauty, its workability, and its hard, smooth surface. It does not crack or splinter, is highly resistive to moisture, and never warps when properly handled. Send for the Presdwood booklet. A check mark on coupon brings your copy FREE.

Send for FREE Booklet

Mail the attached coupon today. It will bring you the interesting Masonite booklet every home owner or prospective home owner should have.

Masonite Corporation, Dept. D-11 © 1930, M. C
111 W. Washington St., Chicago, Ill.
Please send me, free, the story of Masonite.

Name.....
Street.....
City..... *State*.....
☐ If interested in Masonite Presdwood, check here.

Our Readers Say

You Have a Real Idea Here!

IN THE September issue of POPULAR SCIENCE MONTHLY, a Bostonian says your magazine should be barred from the mails because of your articles describing the conditions of the United States Patent Office. I think that Bostonian owes your magazine an apology. If he thinks he is being patriotic by defending the Patent Office, he is all wrong. If no one criticises the conditions prevailing therein, how can we ever expect an improvement? He who dares to tell the truth is likely to be called crazy and unpatriotic, but if the Editor of POPULAR SCIENCE MONTHLY remedies the evils in the Patent Office, he will have done something for the people of this country for which he deserves credit. If your Boston reader thinks your fine magazine should be barred from the mails, I think he should be barred from ever again getting a copy of POPULAR SCIENCE MONTHLY.—A. E. A., Stromsburg, Neb.

Doubts Enslow And Has a Reason

I DON'T see why an airplane motor should come to a standstill when the load is removed from it, as Randy Enslow says. As nearly all modern planes are equipped with gasoline pumps, a motor ought to keep functioning when the load is removed. This pump is supposed to furnish the motor with gas as long as the motor keeps running. Even if the plane is not so equipped, the motor ought to keep on making enough revolutions to start its work all over again when the carburetor gets full the second time, unless the pilot cuts the gas down and turns the switch off. Keep publishing articles on aviation. I can hardly wait for the next issue of your magazine.—R. L. M., Bruni, Texas.

Fire 150 Years Old Still Going Strong

IN A recent issue of POPULAR SCIENCE MONTHLY, you mention "Long Burning Fires Hold Endurance Record." Here is a fire that makes those of which you wrote appear as of only yesterday: Two years ago, when making a trip down the Mackenzie River to the Arctic, we passed, near Fort Norman, a seam of coal that had been burning continuously since, and perhaps prior to, 1778, when Mackenzie discovered the river that bears his name, and which he mentions in his journal. This, as you will observe, covers a period of more than 150 years. Unfortunately there is no hope of its immediate extinction.—J. D. H., Wellington, Ontario.

Thunder Mystery From Cape Cod

AN ARTICLE in POPULAR SCIENCE MONTHLY, on "Lake Thunder Mystery," gave me an explanation of something that has bothered me for many years. I have heard this noise many times on the Bay shore at Provincetown, Mass., where I live. No one was ever able to account for the distant noise which sounded to me like explosions of gas. Long ago I gave up trying to explain the mystery and thought that it occurred nowhere else.—J. R. S., Provincetown, Mass.

Something New About Ultra-Violet Rays

UNDER the heading "Electric eye guards against sunburn," you say, "it showed how ordinary window glass shuts out ultra-violet rays." This adds to two popular misconceptions; first, that there is ultra-violet light in sunlight; secondly, that glass is opaque to ultra-violet light. Without going into experimental detail I would sum up the situation as follows: Only on exceptional days is there ultra-violet light in sunlight. On a few of these days there is ultra-violet radiation of wave lengths so short that it is absorbed by ordinary window glass. The best of the commercial ultra-violet transmitting glasses transmit this additional radiation. Any glass in household use is soon covered with a thin film of dirt that is opaque to ultra-violet radiation. This film is not removed by ordinary washing. Thus any type of window glass soon becomes opaque to ultra-violet radiation. It would take the best part of a week to make satisfactory measurements to prove all this and there is not much readily accessible literature on the subject.—R. B., Department of Chemistry, Yale University.

Send the Answers With Your Puzzles

IT WILL assist us greatly if readers who contribute puzzles to this department will let us have the solutions at the same time. This will facilitate the checking of solutions submitted by other readers and will insure the publication of the correct answer in a later issue of the magazine.—The Editor.

Here's a Poser for A. V's Bone Remedy

I WISH A. V., of New York City, would please tell me how people who have had their bones softened and stretched could, at the same time, have their muscles and tendons stretched so that they would fit the new sized bones and result in no injury to the tissues. Also what would the people do who had their bones pressed together to make them shorter? Would they tie knots in their muscles? Surely, A. V., you cannot expect POPULAR SCIENCE MONTHLY to see any blessing in your idea. How did you ever originate it, A. V.?—H. McK., Lowell, Mass.

Inventing Keeps Him On the Jump

AS AN amateur inventor I have constructed a simple sun-heater that, on hot summer days, heats water steaming hot without the use of mirrors or lenses. Also I have reduced the weight and pressure on a phonograph needle so that it plays two and one-half records instead of only the one it was built for. I can lie in bed and turn on and off an electric light in the ceiling of the room and lower or raise a shade to see how the weather is. I am at present experimenting with a new kind of electric switch.—H. N., Lodi, N. J.

Horse Sense, Not Algebra, Needed Here

HERE'S a little problem to test your wits, and there really is just one answer to it. You better forget your algebra and use your horse sense on this one: A man rowed upstream one mile and threw out a bottle. Then he continued rowing upstream for ten minutes longer. He then rowed downstream until he caught up with the bottle and found that he was back at his starting point. How fast was the stream flowing?—T. R. W., Pittsburgh, Pa.

Pins His Faith to Future Airplanes

IN SO fine a magazine as POPULAR SCIENCE MONTHLY, it certainly is a shame to read letters knocking aviation. H. H., of Illinois, my own state, says that airplanes will never be used as a safe means of transportation. For instance, he says that if the plane's motor doesn't maintain flying speed, the plane will crash. Now seven times out of ten, the plane won't crash, but will glide safely to earth. Also, the airplane engine is now so vastly improved that few accidents caused by power failure occur. Letters like H. H.'s, coming in the face of record-breaking endurance flights, may hurt aviation with the public and I know POPULAR SCIENCE MONTHLY is with me in desiring to promote aviation. Another writer objected to aviation

Boys!!! $50,000

to be distributed in 964 *AWARDS*

Four University Scholarships . . . 96 Trips to Detroit . . and $16,000 in Gold . . . Therefore

Be Sure You Enroll in the

FISHER BODY CRAFTSMAN'S GUILD

It may mean a college education . . .
a distinguished career . . . a lifelong success for you

Opportunity **beckons to every boy in the United States who enrolls in the Fisher Body Craftsman's Guild.**

Established to honor and advance the art of fine craftsmanship, the Fisher Body Craftsman's Guild has decided on a series of valuable awards for those boys in its membership who exhibit surpassing skill in handicraft.

Four University Scholarships, of four years each, and each valued at $5,000, 96 state awards, and many general awards are included in the grand total of awards valued at $50,000.

Distinguished teachers, famous engineers, great editors and industrial leaders unite in saying this is the greatest opportunity ever offered to boys in the United States.

A COACH MODELING CONTEST TO DETERMINE WINNERS

The test of craftsmanship will be a friendly rivalry in coach modeling.

Each member of the Guild will be supplied with complete working drawings for the modeling of miniature Napoleonic coaches.

A jury of able, learned and impartial educators, with National Scout Commissioner Daniel C. Beard as Honorary President of the Guild, will pass on the models submitted, and present the awards.

AWARDS
valued at $50,000

The following awards will be made to winning Guild members.

GRAND NATIONAL AWARDS

4.....University Scholarships

GRAND STATE AWARDS

96....Trips to Detroit and $50 in Gold

96 (*Second Awards*) $50 in Gold

GENERAL STATE AWARDS

96 Wooderaft—$10—1st award
96 Wooderaft—$ 5—2nd award
96 Metalcraft—$10—1st award
96 Metalcraft—$ 5—2nd award
96 Trimcraft—$10—1st award
96 Trimcraft—$ 5—2nd award
96 Paintcraft—$10—1st award
96 Paintcraft—$ 5—2nd award

Half of the above awards go to the Junior Group (ages 12 to 15 inclusive) and half to the Senior Group (ages 16 to 19 inclusive).

Every enrolled member who submits a completed coach to the Guild Headquarters will be awarded a Diploma for Craftsmanship.

Every boy in the United States between the ages of 12 to 19 inclusive, is welcomed into the Guild and the Coach Modeling Competition. There are no entrance fees or dues.

ENROLL NOW AT ANY GENERAL MOTORS DEALER'S

You have only to go to any General Motors Dealer in your community, and say you want to join the Fisher Body Craftsman's Guild.

Dealers in Cadillac-La Salle, Buick, Oldsmobile - Viking, Oakland-Pontiac, and Chevrolet cars are all General Motors Dealers. There is one in your community.

The General Motors Dealer will welcome you, give you complete information about the Guild, and enroll you.

When your enrollment is registered by the Guild, you will receive your pin, the official emblem of the Fisher Body Craftsman's Guild, your certificate of membership, and full details of the Coach Modeling Competition, with complete working drawings of the model you are to reproduce.

***Membership in the Guild is still open but you will act wisely if you act quickly*—which is to say SEE A GENERAL MOTORS DEALER TODAY!**

FISHER BODY CRAFTSMAN'S GUILD

Sponsored by **FISHER BODY CORPORATION, DETROIT** *Division of General Motors*

articles in your magazine on the ground that it isn't a science. Whether this is true or not, your articles on flying constitute one of the main reasons for my partiality for your magazine. But I like everything else in it and I hope you do not listen to the knockers who want you to take out the things they don't like.—H. B., Chicago, Ill.

Altogether, Now: What's the Answer?

WHAT is the principle governing the movement of liquids and gases moving through a pipe under constant pressure? For instance: Water flowing through a twelve-inch pipe is held under constant pressure by a two-inch outlet. Ignoring side friction, would the velocity of the water be the same at all points of a cross section of the pipe? Would the movement of the water be uniform, as a solid, or would the velocity vary at different points in the cross section? Under similar circumstances of constant pressure, would gas move with uniform velocity at all points in a cross section? I wish some reader of this department would give me the information I have asked for.—C. W. W., Kingston, Pa.

Parachute Jumping Has Him Bothered

I HAVE been reading five different magazines, including POPULAR SCIENCE MONTHLY, during the last five years, but I could never find as many up-to-date articles in any other magazine as I do in POPULAR SCIENCE. This is especially true on aviation. There is one thing about which I don't agree with you, however. You say that a parachute jumper cannot fall faster than 118 miles an hour. I think that is wrong, if what I once learned is true. I think that it all depends on the weight of the pilot, weather conditions, up or down currents, and the size of the parachute.—S. M. M., Ignace, Ontario.

Why Don't Doctors Grab New Methods?

IT SEEMS to me that the latest discoveries in medical science and treatment, mention of which you so often make, should be more generally used by doctors. At least, up here, there seems to be wide use still made of old methods though new and better ones have been discovered and their value proved. I do not see how you can improve your magazine, and why those who do not care for certain departments voice their disapproval, I do not understand. That seems to me to be at least selfish. How could you confine yourself to one line only, when science covers everything?—E. S. D., Middletown, N. Y.

Just the Truth and No Shielding

I READ with interest your articles about the Patent Office being a national disgrace. I have also just been reading the comments in "Our Readers Say" page. When reading your articles, my own experience made me think that you purposely had put everything mildly in order to shield the Government from being accused of gross misconduct (for which I did not blame you). However, if your correspondent, I. U. T., Boston, Mass., who calls your magazine a valueless monthly, will look up the patent office records of Serial No. 23,589 and Serial No. 203,141, he will think differently if he is an honest man. In justice to the Patent Office, though, I want to say that I do not blame that office altogether in my case.—J. K., San Luis Obispo, Calif.

Only a Bird in a Gilded Cage

TONIGHT, while reading through the "Our Readers Say" columns, I was reminded of a problem I have spent a good deal of time trying to solve, but so far have not arrived at any very definite conclusion. Perhaps some of your readers could help me out. A bird sits on his perch in a wire cage. The cage is then weighed. Later, when the bird is flying around inside the cage, it is weighed again. Would the results be the same? Now take an inclosed cage; under the two above conditions would there be any change in the weights? It seems to me that "no" is the answer to both those questions, but I have had so many people try to convince me I'm wrong, that I confess I'm not sure which is right.—Miss N. O., Piedmont, Calif.

W. W. H. Gets a Jolt From Palestine

MY CONTEMPORARY and fellow reader of POPULAR SCIENCE MONTHLY, W. W. H., of New York City, is, I fear, the type of man who blindly and naïvely believes that "science will find a way." This blind faith in science to look after the future is indefensible. That is not a new type by any means. Allow me to recall to you such statements as, for instance, "The great forests in the West are inexhaustible—superabundant for all foreseeable time." W. W. H., in his letter published in this magazine, states that "in a very few years the only place coal will be used will be in the public museum, to show the coming generation what was once used for fuel." And, I might add, in the next case in that museum will be an oil burning heating unit to show the people of that age what a disgracefully inefficient, wasteful and selfish method their forefathers of the twentieth century employed to use *their* oil.—R. S. L., Haifa, Palestine.

Can't Get Enough Articles on Aviation

YOUR articles on aviation and the Model Garage are sure fine. Please give us more dope on aviation. As this method of travel is now taking its place among other modes of transportation, I think we need much on the subject to educate us in this line as it grows up.—T. D., Richmond, Ind.

Let the Turkey Exterminate Locust

YOU might suggest to these eastern gentlemen who are out to destroy the locust, the adoption of a few of our sacred American birds, the bronze turkey, whose favorite diet is a quart of grasshoppers every twenty-four hours. Semiarid climates are ideal for turkey propagation. The turkeys would eat the locust and the natives eat the turkey, unless they preferred to add them to their list of objects of worship, the sacred cow, etc. However, in this country we do not worship the turkey, but incorporate him as part of our system at least twice each year. Your articles on our National Antique Shop (The Patent Office) were very timely, as I cannot recall any improvement in methods since its organization.—W. G. B., Haynesville, La.

Luggage Problem Solved by Algebra

IN THE September issue of POPULAR SCIENCE MONTHLY, H. O. H., of North Tonawanda, N. Y., asks for the solution of a problem in which luggage is divided between A, B, and C. I have solved it and submit my answers as follows: A's luggage weighs eighteen and one third pounds; B's fifty pounds and C's sixteen and two thirds pounds. For H. O. H.'s benefit, I will say that I solved the problem algebraically.—J. R., Georgiaville, R. I.

State Museum Wants Our Models

I HAVE been much interested in your articles and models of the old-time stagecoach and covered wagon. We should like to obtain such models for our State Museum here.—L. R. H., Denver, Colo.

Worse Than Mystic; It Sounds Fakey

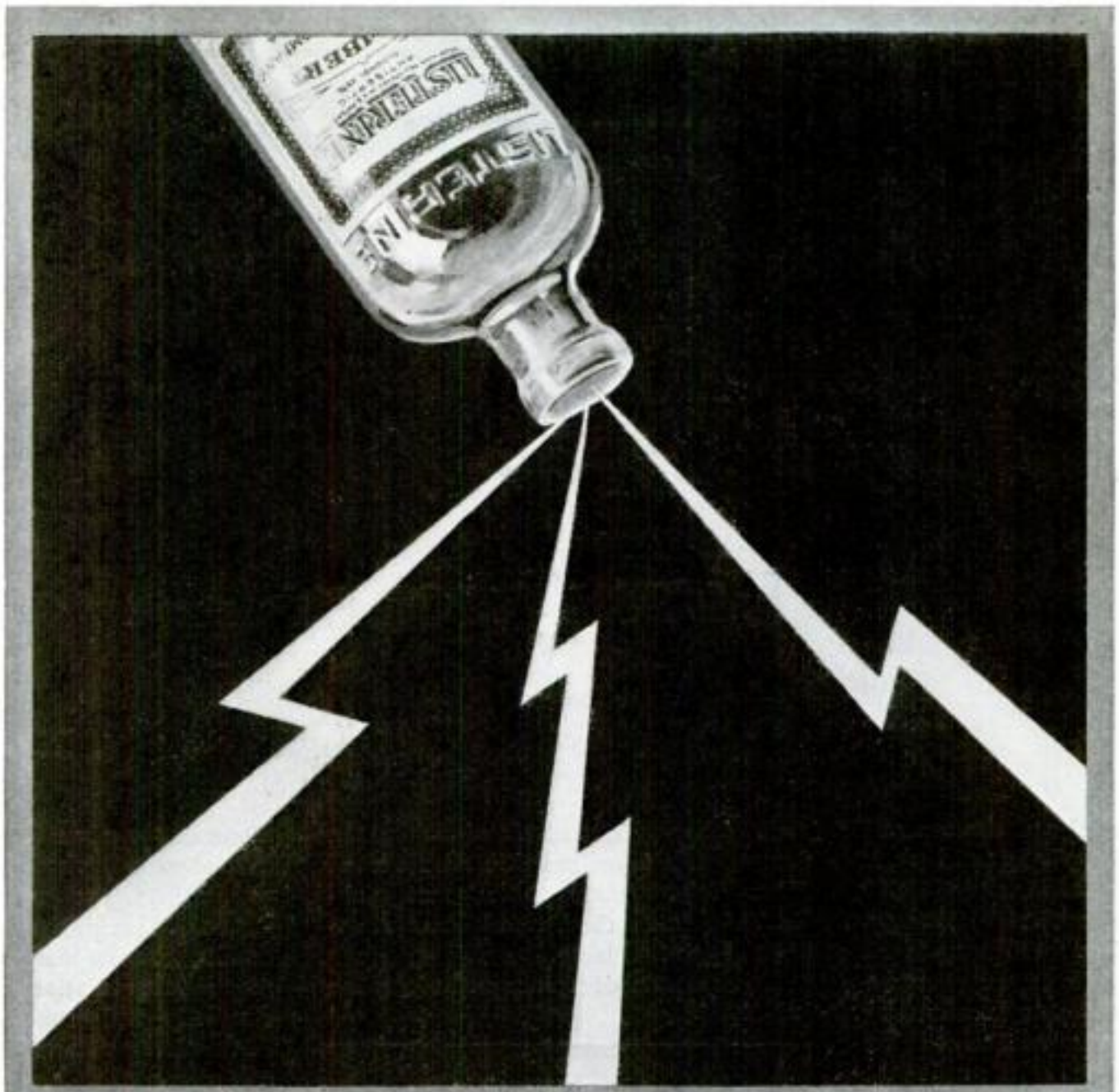
READING your excellent article on Montgomery, the pioneer aviator, in October POPULAR SCIENCE MONTHLY, reminded me of something I want to ask you and your readers: In the books somewhere, I once read that hundreds of years ago a Chinaman flew with movable wings, patterned after those of a bird and worked by his arms and legs. Is there any truth to this? Do reputable Chinese historians make any such claim? And where can I get an authoritative answer? Will some of your readers help me get the truth? Do you suppose this is just another mystic tale out of the Orient?—C. P. L., Austin, Minn.

Enters Request for Construction Articles

I HAVE used several of your blueprints, especially those for ship models, and consider them equal to the three and four dollar prints supplied by others. Have been a subscriber for some time and prior to subscribing I purchased your magazine for years. My file is indexed and is useful to myself and friends who also have workshops. I hope to see more ship model construction articles in your magazine, as there seems to be so few people who care for building furniture. Why not give us a few articles on model railway construction?— L. E. R., Algiers, La.

Try and Drill Your Way Through This One

HERE'S one to keep your readers busy: A two-inch hole is drilled perpendicular to the axis of a two-inch cylindrical rod. How much material is removed if the axis of the hole passes through the center of the rod? . . . I certainly enjoy your magazine. It is not too technical to be readily understood, and yet it is not too simple.—J. E. N., Durango, Colo.



Instant death to germs of disease!

Think of it! — a non-poisonous mouth wash absolutely harmless, pleasant to taste, healing to tissue; *yet with power to destroy germs by the millions.*

Such is Listerine, for fifty years the outstanding antiseptic and germicide for oral hygiene.

for COLDS

for SORE THROAT

Every type of dangerous germ swiftly succumbs to it. Among them are the Streptococcus Hemolyticus, the organism associated with sore throat, Micrococcus Catarrhalis (catarrh) found frequently with colds, and the Pneumococcus (Pneumonia).

Enemy of infection

Even Staphylococcus Aureus (pus) and Bacillus Typhosus (Typhoid), germs specified for test purposes because of their resistance to germicides, yield to it. Listerine kills them in counts ranging to 200,000,000 in 15 seconds (fastest killing time science has accurately recorded).

Now you can understand why full strength Listerine is so successful in guarding against colds, sore throat, and other infections. Why, also, it combats these diseases once they have gained a foothold.

Reduces mouth germs 98%

The moment Listerine enters the mouth it attacks the millions of bacteria breeding there — kills them outright. The number of bacteria on the surfaces of the mucous membrane is actually reduced 98%. This has been clearly demonstrated by repeated tests made under methods employed at Johns Hopkins, Pennsylvania, and Yale Universities.

Gargle every 2 hours

Make a habit of using full strength Listerine as a mouth wash and gargle every night and morning. This treatment under normal conditions of health is considered sufficient to keep mouth germs under control and maintain a clean and healthy condition in the oral tract.

When, however, you have a cold or sore throat consult your doctor and increase the frequency of the gargle to once every two hours.

Thus you give nature an extra attacking force needed when body resistance is low, to keep disease germs under control. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

Listerine · safe · non-poisonous

KILLS 200,000,000 GERMS IN 15 SECONDS

THE SECOND OF A SERIES OF ADVERTISEMENTS DEALING WITH ULTRA-VIOLET RADIATION IN THE HOME

What may we expect of ULTRA-VIOLET *Radiation?*

SCIENCE has analyzed the sun and found that, besides light and heat, it gives off tiny invisible waves (70,000 to the inch), known as Ultra-Violet rays, which have a profound effect upon all manner of life. Just as our eyes are receiving sets tuned to the mighty broadcasting of light given off by the sun, so our skin is tuned to the invisible health waves sent out by the same source. Though they penetrate the skin no deeper than the thickness of this sheet of paper, these rays are able to work deep changes throughout the entire body. Vitamin D—the sunshine vitamin—is produced only under its influence. This vitamin is an aid in the depositing of calcium and phosphorus and other minerals in the bones.

These vital rays stir up many of us mentally. They help to build up resistance to disease. They tan our skins (though it is not necessary to tan to receive the benefits of ultra-violet radiation). They are a powerful aid in the maintenance of health.

But Ultra-Violet, artificially produced in the home, should not be regarded as a 'medicine.' It should be regarded in the same light as fresh air, pure water and wholesome food. And like all of these essentials of health it should be used with moderation.

Like all great discoveries, Ultra-Violet radiation has been the subject of much misconception and misunderstanding on the part of the public. Its curative powers, in general use, have been exaggerated, in some cases by commercial exploiters. Ultra-Violet radiation is not a "cure-all." It is not a substitute for the services of a physician in the case of illness or disease. In all cases where Ultra-Violet radiation is indicated *as a treatment of disease*, the attending physician should prescribe and supervise the treatment.

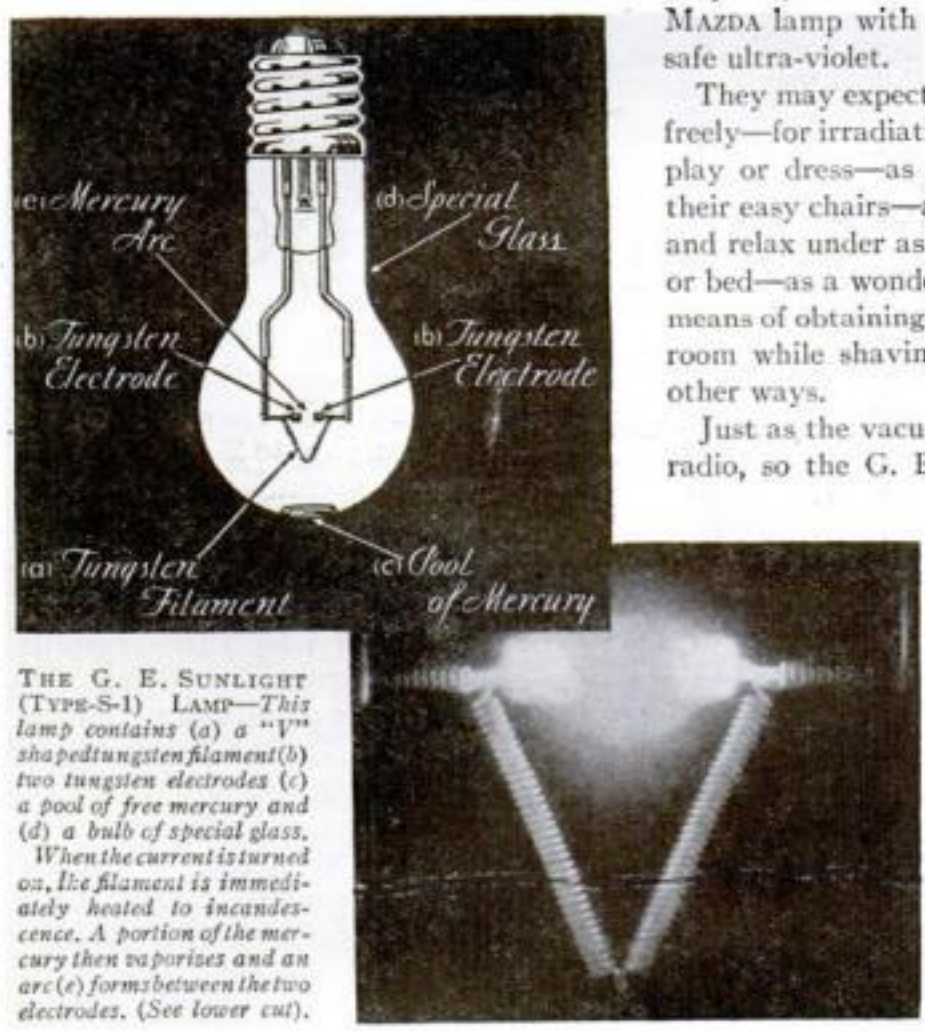
For many years, as the world's largest manufacturer of things electrical, the General Electric Company has sought, in its vast laboratories, a means of making the known, health-maintaining qualities of Ultra-Violet available to the general public. The result is the General Electric Sunlight (Type S-1) lamp.

To be worthy of a place in the long line of General Electric products, this lamp had to be efficient. It is. It is not merely a "heat" lamp. At a distance of three feet, from a standard utilizing the G. E. Sunlight (Type S-1) lamp the public may expect the same ultra-violet effectiveness as is found in mid-day, midsummer sunlight.

To be a G. E. product it had to be safe. It is. The bulb of the G. E. Sunlight (Type S-1) lamp is made of special glass which filters out nearly all radiation not found in the best natural sunshine. In any standard or fixture using the G. E. Sunlight (Type S-1) lamp (the lamp cannot be used in the ordinary lamp socket) the public may expect radiation which embodies the simplicity and economy of the modern MAZDA lamp with an adequate supply of safe ultra-violet.

They may expect to use such equipment freely—for irradiating the children as they play or dress—as a reading lamp beside their easy chairs—as a lamp to stretch out and relax under as it stands by the couch or bed—as a wonderful sewing light—as a means of obtaining "sunlight" in the bathroom while shaving—these and in many other ways.

Just as the vacuum tube is the heart of radio, so the G. E. Sunlight (Type S-1) lamp is the heart of modern man-made sunlight. Everyone who expects to obtain the *full* benefits of ultra-violet radiation this winter should insist that the sun lamp he buys uses the G. E. Sunlight (Type S-1) lamp as its source of energy. It is sold in accordance with the requirements of the Council of Physical Therapy of the American Medical Association and is backed by the greatest name in electricity.



THE G. E. SUNLIGHT (TYPE-S-1) LAMP—*This lamp contains (a) a "V" shaped tungsten filament (b) two tungsten electrodes (c) a pool of free mercury and (d) a bulb of special glass. When the current is turned on, the filament is immediately heated to incandescence. A portion of the mercury then vaporizes and an arc (e) forms between the two electrodes. (See lower cut).*

The Incandescent Lamp Department
of General Electric Company
Nela Park, Cleveland, Ohio

GENERAL ELECTRIC
SUNLIGHT (TYPE S-I) LAMP

Join us in the General Electric Program, broadcast every Saturday evening on a Nation-wide N. B. C. Network.

Popular Science MONTHLY

NOVEMBER, 1930 RAYMOND J. BROWN *Editor* VOL. 117, NO. 5

Radio Aids Police in Swift Arrest of Crooks

By EDWIN W. TEALE

C. H. Kelley, Chief of the Pasadena, Calif., Police Department, uses the radio to send out orders to men in cruising cars.

Sets in Cars May Soon Make Nation One Big Detective Bureau

ON THE outskirts of Lansing, Michigan, a one-story brick building is the heart of an experiment watched by the whole nation. Here, a few days ago, Governor Fred W. Green threw a switch and the first state-wide police radio hook-up was an actuality.

With the speed of light, radio waves will race from this broadcasting station warning state, county, and local police to watch for fleeing criminals. A few seconds after news of a crime is received, the entire state can be the scene of a concentrated man hunt.

Similar broadcasting stations, planned in other parts of the country as an offensive against crime, give radio a place as one of the most effective weapons of law enforcement.

Just before Congress adjourned last spring, President Hoover requested an appropriation to put receiving sets in sixteen police cars in the District of Columbia. In more than forty large American cities, scattered from coast to coast, radio equipped police cars are patrolling the streets.

In Detroit, Mich.; Indianapolis, Ind.; Seattle, Wash.; Dallas, Texas; Cleveland, Ohio; and other cities, radio has demonstrated its value in saving seconds in the race with crime. In twenty months 1,800 "radio arrests" were made in Detroit, and the average time for each arrest was *ninety seconds.*

One of the fastest of these radio-directed captures was accomplished shortly after one o'clock one night last winter. Cruiser

Radio has proved a potent weapon against burglars and holdup men who are captured before they have a chance to escape from the scene of their crime.

car No. 5 of the McClellan Station was patrolling its section of Detroit when it was ordered to a home where burglars were reported in the basement.

It reached the address in one minute flat. But that time was too slow. Scout car No. 52 had picked up the message when it was a block from the house. In less than thirty seconds the surprised burglars were under arrest.

Even more surprised were two negro bandits caught in Indianapolis on the night of January 12 last. A few minutes after they had staged a hold-up, the following alarm went out over the air to the police radio cars:

"Two negroes held up a filling station at Senate Avenue and Eighteenth Street. One is about twenty-eight years old; five feet four inches tall; very black; speckled coat; wore cap. Other wore brown coat, drove car. Escaped in Ford Tudor, Michigan license 648-???, last three numbers obliterated."

Every time such an alarm is broadcast, it is repeated three times so there will be no mistake about details. One of the police cars picked up the message near the scene of the crime and captured the thugs before they had gone six blocks.

As the negroes were hauled into the police car, the third broadcast was just beginning. One of them rolled his eyes at the little box and said: "Bo-o-y! Listen to that thing a tellin' on us."

Another record-setting arrest was made not long ago by the crew of Chene Station cruiser No. 7 in Detroit. At 12:06 A. M. an alarm was sent out that prowlers were breaking into a grocery store. No. 7 at the moment was turning into the street upon which the store was located, just nine doors from the building itself. Before the announcement was completed, the burglars were under arrest.

But, what probably set an all-time speed record for a "radio arrest" was one made in Oak Park, Ill. It was accomplished in exactly nothing flat! The crew of the machine was waiting at a street corner for a traffic light to change when the loudspeaker started a description of two men that had fled in an automobile after stealing cash registers.

Just at that moment, another machine pulled up beside them, stopped by the red light. In it sat the wanted men. All the officers had to do to make their arrests was to step from one running board to the other!

In the days before the radio and the automobile were combined to make possible such amazingly speedy arrests, police cars were out of touch with headquarters for long stretches of time. Telephones permitted them to call back occasionally and more recently the teletype, printing out messages sent by wire, was installed in substations.

But even then, a car might be cruising within a block of the scene of a crime and the crew know nothing of it until they called headquarters on the telephone to get instructions. Now, they can be reached instantly no matter whether they are in the canyon streets of the downtown district or in the relatively open spaces of the suburbs.

Not only can they be given the original instructions that start them on a chase, but additional clues and details that develop while the pursuit is in progress can be relayed to the police machines.

The messages come in as clearly at seventy miles an hour as at fifteen. The installation of radio has turned police automobiles into "bloodhound cars" that pick up the scent as they race in pursuit of a fleeing quarry.

An example of how such additional information aids a chase was told to me recently by Andrew J. Allen, chairman of the Citizens' Police Radio Commission of Indianapolis. While two officers there were cruising about the northeast section of the city in their radio car, the loudspeaker gave out the alarm that a filling station had been robbed in their territory.

They had hardly reached the scene when the loudspeaker barked again. Another station had been held up half a mile away. The description of the second bandits tallied with the first. The car raced in pursuit.

On the run, information came that a car believed to be that of the bandits was heading downtown. A few minutes later the officers spotted the machine parked in front of a house, the motor still running. Inside the police found the thugs, still in possession of the money, hiding in closets.

Frequently the witnesses of a crime think of additional details after the first excitement has passed. These are now relayed to the automobiles while they are going at full speed. Also, when one crew

Police radio station WMDZ of Indianapolis. Its builder, R. J. Batts, at right.

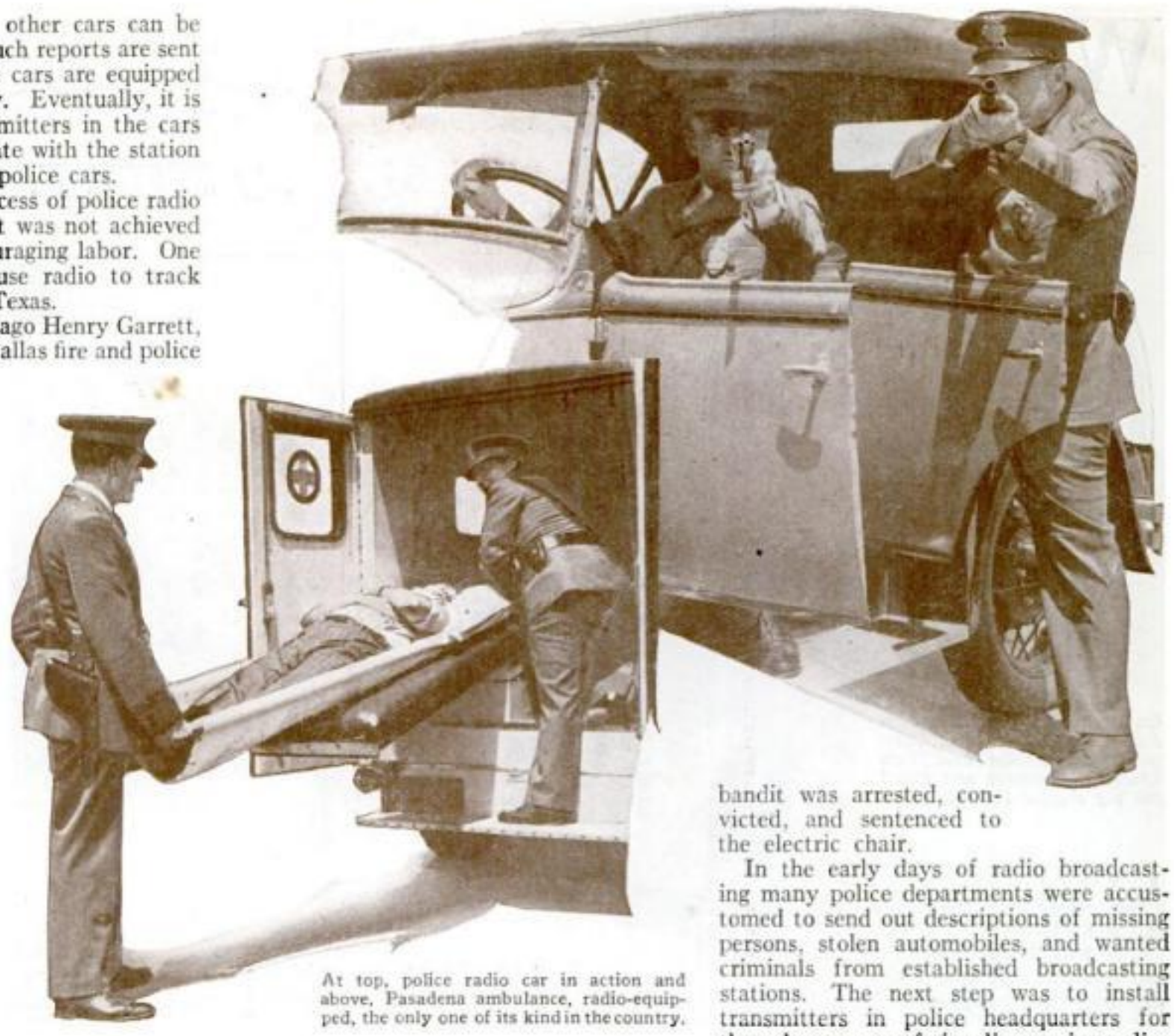
Sergeant William H. Burkuhl, of the Detroit force, tunes in on set used in a police car.

reports a capture, the other cars can be called off the chase. Such reports are sent in by telephone, as the cars are equipped with receiving sets only. Eventually, it is planned to place transmitters in the cars so they can communicate with the station houses and with other police cars.

While the recent success of police radio has been spectacular, it was not achieved without years of discouraging labor. One of the first cities to use radio to track criminals was Dallas, Texas.

About thirteen years ago Henry Garrett, superintendent of the Dallas fire and police department signal system and a pioneer in radio, installed a transmitter in police headquarters. With this he sent out descriptions of criminals and missing persons. This station, WRR, is said to bear the distinction of being the first municipal radio station in the United States. When first opened by Garrett, of course, only a few amateurs had receiving sets to hear the broadcasts that were sent out over the air.

Through the intervening thirteen years, WRR has grown into a large broadcasting station, well-equipped and with international reception. It has maintained, however, its status as a municipal station and has kept a close eye upon its "detective work." Only last year, one of its broadcasts resulted in bringing to an end the "One-Man Crime Wave" for which "Dagger Bill" Pruitt, a cold-blooded gunman of the Southwest, was responsible.



At top, police radio car in action and above, Pasadena ambulance, radio-equipped, the only one of its kind in the country.

For weeks, this desperado terrorized Dallas with nightly holdups. Practically the whole detective force was assigned to the case, but little was accomplished. One night, a victim resisted and the thug shot him dead. The next night, the robberies continued.

In desperation, the police broadcast every detail of the holdups, the fact that the stick-up man swaggered when he walked, and all the vague reports that might result in his identification. The result was that a small boy said to his father:

"I know who that is. It's 'Dagger Bill' Pruitt. I'll bet a dollar!"

On his way to school, he had seen the swaggering bully loafing on a street corner. The father communicated with the police with the result that the bandit was arrested, convicted, and sentenced to the electric chair.

Radio police car that picks up warning messages while speeding through Indianapolis streets.

By means of radio messages it is possible to arrest criminals before they have a chance to dispose of stolen goods in pawnshop or elsewhere.

In the early days of radio broadcasting many police departments were accustomed to send out descriptions of missing persons, stolen automobiles, and wanted criminals from established broadcasting stations. The next step was to install transmitters in police headquarters for the sole purpose of signaling roving police cars equipped with receiving sets, especially at night.

ONE of the first cities to transmit alarms to police cars was Detroit, Mich. Its first radio car was put into operation in 1921. Tantalizing years of partial success followed. Reception by the sets was uneven and the hard usage they received frequently put them out of order.

In 1927, Commissioner William P. Rutledge, who had fathered the idea, was forced to close down the sending station. It was suggested that the equipment be sold. The experiment apparently had failed.

At this point, Kenneth R. Cox, a young traffic cop whose hobby was radio, asked permission to try his hand at "ironing out the bugs" of the system, and his request was granted. With the aid of Patrolman Robert Batts, and several other radio fans on the force, he began work.

The sending station was

(Continued on page 140)

Why Midget Golf Swept Country

By JESSE F. GELDERS

On Lookout Mountain, in Tennessee, Garnet Carter of Chattanooga built the first Tom Thumb golf course and found his big regular links deserted.

Laying the fairways on a miniature course while an electrician installs lights, essential to its success.

Not all of the midget links use cottonseed greens. This course is being covered with special quality felt.

SHOWMANSHIP and mechanical art will decide the fate of America's newest big industry—miniature golf.

Winter's approach has been a reminder of its uncertainty to a quarter of a million vitally interested people. They are confident that fresh ideas, well kept courses, and human nature will keep it growing.

The life of miniature golf has a direct bearing on the incomes of a hundred thousand course owners, employees, contractors, and others immediately connected with the business. Probably a hundred and fifty thousand more are appreciably affected through the sale of various supplies, and the performance of occasional services. To a slighter degree it touches a number that cannot be guessed at.

Its influence ranges from the obvious to the remote; from the New Jersey factory that is marketing a "miniature golf green" paint to the men engaged in gathering seaweed, which, after the removal of chemicals, is shipped by hundreds of pounds from Florida to be used as one type of surfacing material for fairways and greens.

All these people are wondering how long this newest fad will last. Will it blossom again in the spring like a perennial plant or will the frost and snow give it a permanent setback?

In the North and East it appeared with a bang last summer. In the South and West it has already survived a winter.

In the colder parts, mechanical ingenuity is at work to cultivate it indoors. Even motion picture theaters have been converted into miniature courses. New designs are being created to suit it to smaller indoor areas.

Meanwhile, outdoor owners are becoming convinced that to recapture their trade, with the return of spring, grounds must approach mechanical perfection. Individual owners and producing factories are considering new devices to keep interest alive.

It was a combination of novelty in construction, with the use of a peculiar material, that gave this amazing industry its start.

THE first course of the present type was built two years ago by Garnet Carter, real estate operator and hotel man. He owned a regular golf course at his inn on Lookout Mountain, near Chattanooga, Tenn. He had a bit of ground left over, and decided to provide a smaller "putting" course for guests who might not wish to go around the larger circuit.

A New York architect designed this smaller course, which is about three times the size of the average small course. Rock tunnels and hollow logs were the chief obstacles. The "greens" were made of a compound of cottonseed hulls, dyed green. This cottonseed was shortly to become an important factor and a point of hot dispute.

Carter soon found that his miniature course was far more profitable than his standard one. Visitors saw it, were struck with its novelty, and had him install similar courses for them. One was built in a city park at Chat-

A typical Tom Thumb golf course, laid out in the heart of New York City. Here all of the ordinary hazards, including hollow logs, found on these links can be clearly seen.

New Craze Has $75,000,000 Invested in 25,000 Courses and a Million Players

In the midst of a rustic setting on Lookout Mountain, this original Tom Thumb golf course was built. Inclined logs and water hazards first used here, proved their popularity.

tanooga, with the agreement that the city would get ten percent of its earnings. In the third month the city's share was more than three hundred dollars.

Other courses were built in various places throughout the South. They were given the name "Tom Thumb," which Carter patented.

Another patent was involved in the rapidly growing business. Some one walking around a cotton gin discovered that cottonseed hulls, when packed down underfoot, had a remarkably level surface. They were tried on golf greens, and proved so satisfactory that they were rather widely used. Three men who had developed the process obtained a patent.

Several years later, a New York company, Miniature Golf Courses of America, Inc., was made licensee for the United States. This firm, to quote its own officers, had been having a hard time. They were building indoor courses, chiefly to attract golfers who wanted to practice putting. Various surfacing materials had been tried, but the courses could not be popularized.

A COTTONSEED course was installed in a building near the New York Curb Exchange. It was an immediate success. This was four years ago. During the next three years, the company built nearly 150 courses.

Several were tried outdoors in amusement parks, but they were unsuccessful. They lacked the theatrical appeal.

This Garnet Carter's courses supplied. The New York company made a deal authorizing him to use the cottonseed compound. With this combination of satisfactory greens, and an appeal to public interest, the game progressed.

But miniature golf was still not a national industry. Another group entered the picture. In Rochester, Pa., the National Pipe Products Corporation had a factory that was turning out check valves and filling station signs. This concern had originally manufactured visible gasoline pumps, in which motorists could see the exact amount of gasoline they were buying.

The gasoline pump business had been disposed of, when two executives of the corporation, W. S. and A. J. Townsend, found miniature golf in Miami, Fla. They recognized the opportunity, and in a few hours were buying miniature golf courses.

THE Townsend's made a deal with Carter and started production in the Rochester factory. At first, eight men were employed in the miniature golf division. Now there are two hundred. They occupy half of a plant with five acres of floor space.

Designed to give a rustic air, the sets manufactured by this company include two hazards made of hollow logs. A search of the surrounding country and neighboring states showed that there were few hollow logs suitable for the purpose, so they were brought from the South. As the business grew, the demand for hollow logs grew, and they were bringing eight carloads at a time. The source of supply was soon exhausted. Thereupon, solid logs were shipped in, and bored hollow.

A DOZEN artists are constantly at work hand-painting logs and woodwork used on the courses. Others are busy fastening bark to the outside of the tiny huts that serve as obstacles.

Factory equipment that formerly prepared standards for filling station signs is busy fitting pipes to the requirements of inclosing greens.

The Rochester plant is one of three operating in the United States under agreement with Carter. The whole of the Americas and all the world has been divided up for manufacturing and sales.

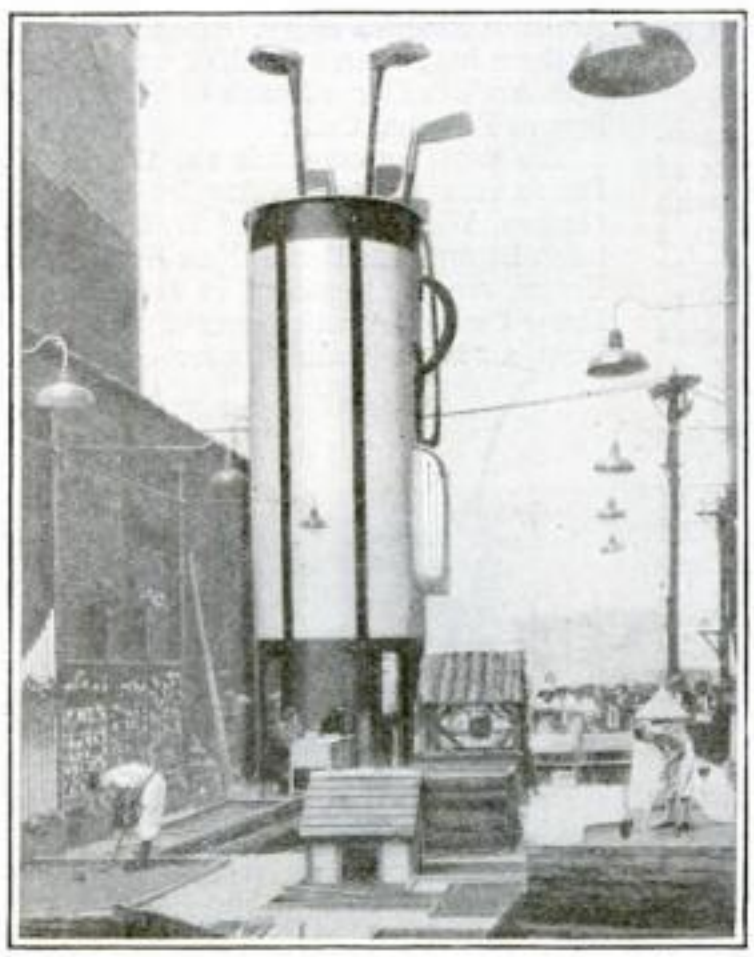
Independent companies and individuals have leaped into the business everywhere. The nation is dotted with golf grounds from the crudest of the homemade type to the most elaborate, custom-built course, with picturesque landscaping and elaborate hazards.

Early in August, the United States Department of Commerce estimated that there were 25,000 courses in the country, and that 15,000 of them had been built since the first of the year.

Many men in the business thought these figures too high at the time. If they were it is pretty certain that the industry now has grown to fit them. The total investment represented is probably around $75,000,000.

Vacant lots have been snatched up for the purpose everywhere. Signboards have been torn down; auto parking spaces have been taken over. New York

[Continued on page 136]



To attract attention to a Jersey City, N. J., miniature course, the caddy house was built in form of a golf bag.

America to Save King of Horses

Jadaan, pure-blooded Arabian stallion used in the movies. Picture shows two outstanding characteristics of the Arab horse—the peculiar shape of the head and the gentle expression suggesting kindness.

Waduda, an Arab war mare, and her three-day-old colt. Mother and child are being taken care of by the Bedouin slave boy, Said Abdalla. Even the colts in this breed are gentle and easily trained.

Few Survivors of Fleet **Arab** *Steeds Left—Plans Are Laid to Rescue the Breed from Extinction*

By JAMES W. BOOTH

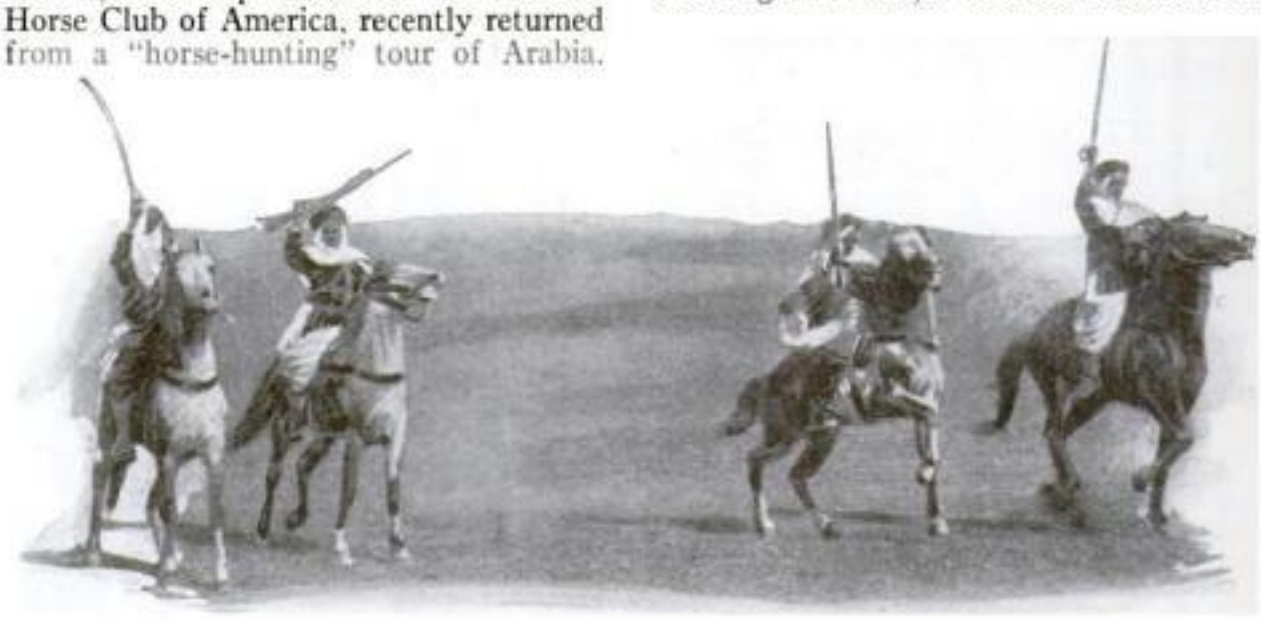
DETERMINED to save the beautiful, fleet-footed Arab, king of horses, which is threatened with extinction in its native home, a few American horse lovers are devoting every effort and vast sums of money to perpetuating the *asil*, or pure Arabian strains, in the United States.

In the Arabian desert, water holes are drying up. Besides, the machine age has invaded those remote sandy plains. The Bedouin, once the most romantic of mounted nomad warriors, has substituted the modern, high-powered rifle for the musket and spear of yesterday, and is beginning to use the flivver for his traveling and fighting. As a result of these changes, the wonder horse, celebrated since Biblical times in a thousand songs and stories, is gradually dying out.

Marked progress has been made already in reëstablishing the breed here, particularly in southern California, where conditions of soil and climate resemble those of the desert. But the work is very costly. That explains why, in a horse population of 18,000,000, there are only 200 pure Arabs in America today. About one third of these have been assembled on the 800-acre Arabian Horse Ranch of W. K. Kellogg at Pomona, Calif.

The next largest studs are the A. W. Harris outfits near Los Angeles and Lake Geneva, Wis., and that of William Robinson Brown near Berlin, New Hampshire. Brown, who is president of the Arabian Horse Club of America, recently returned from a "horse-hunting" tour of Arabia.

The prohibitive cost of Arabian horse breeding explains, too, why it virtually has been abandoned in Europe. Before the war breeding farms were maintained at public expense in Hungary, Germany, and France, but little money for this luxury now is available in these financially hard-pressed countries. In Russia the breeding of Arabs, a tradition established



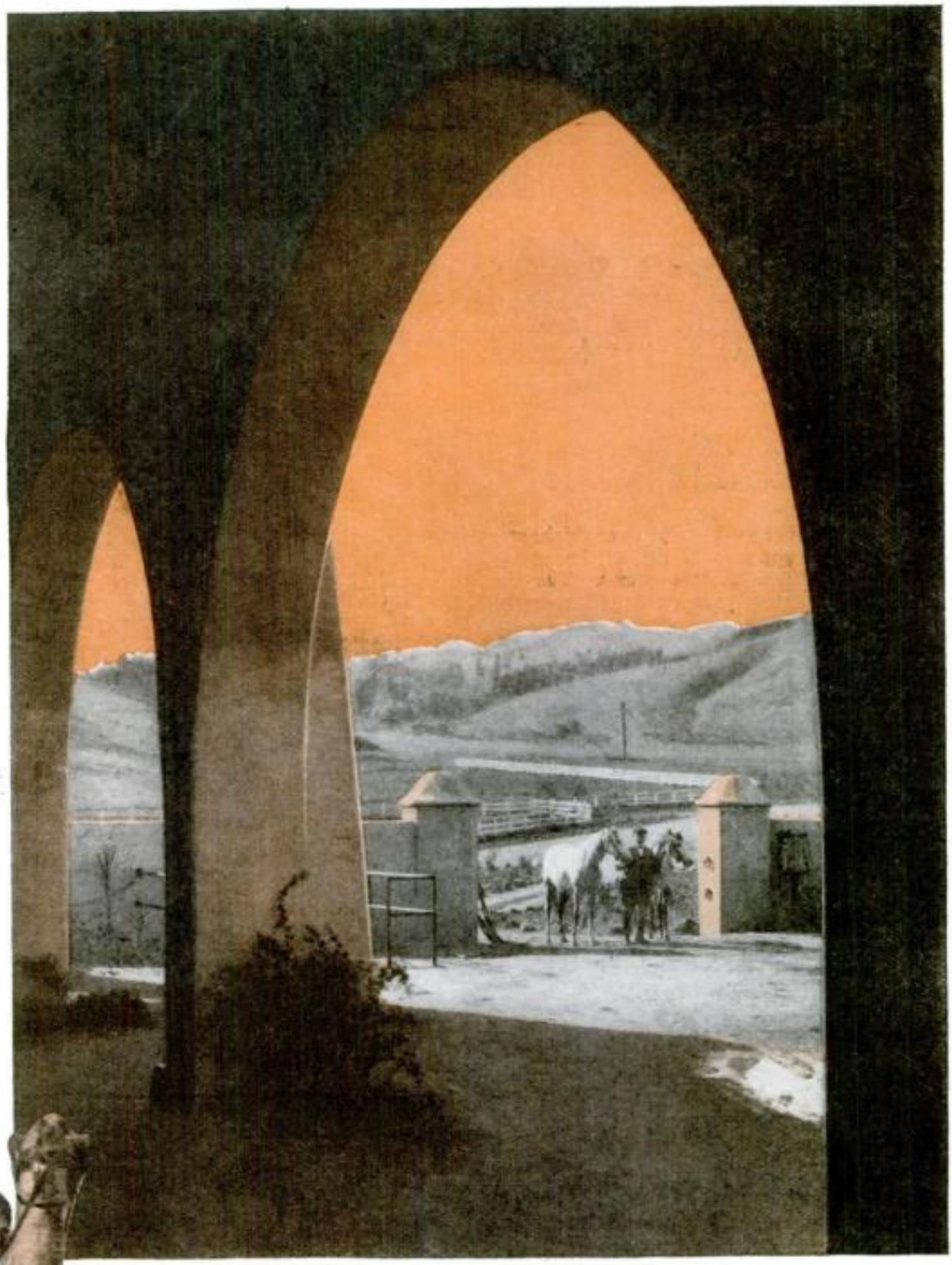
Arabian horses as they appear in action. These intelligent and fearless animals are easily broken to the maneuvers of the Arabian's war tactics and will gladly take part in the fighting.

by Czar Peter the Great in the seventeenth century, has been discontinued since the Revolution.

Thus it is to America that the sportsman must look for his Arabian steeds of tomorrow. While the 200 at present in this country may seem a small number, it is a fair beginning, considering the situation in the desert itself. Here is what a noted authority told me on his return from the Near East the other day:

"Altogether, I have spent eight years among the nomad breeders and examined thousands of horses. On my third and latest trip, I looked at 4,351. Of these, only fourteen mares were absolutely pure strain, and at that rate there can be scarcely more than 800 *asil* horses in the whole of Arabia today. It was almost heart-breaking to see what modern firearms and automobiles are doing to destroy the old Bedouin ideals and, in consequence, to ruin the priceless Arabian horse."

But it is not only the sportsman who is interested in the new American breeding activities. At the Kellogg ranch scientific methods are used to improve the breed by increasing size and speed and improving saddle conformation. The Remount Division, U. S. Army, is following these experiments with the keenest interest. For years the Army has felt the need for improved Arab strains to be used for breeding a better cavalry horse. Courage and endurance are the prime requisites for the ideal Army mount, and nowhere are those qualities obtainable but in a horse with Arabian blood.



A glimpse of the W. K. Kellogg horse ranch where he has sixty of the two hundred pure-blooded Arabian horses in this country. A determined effort is being made to save the breed from extinction.

A pure-blooded Arabian horse in its native land. The Arab is the most tractable of animals, though this picture suggests anything but gentleness. He is merely doing one of his many stunts.

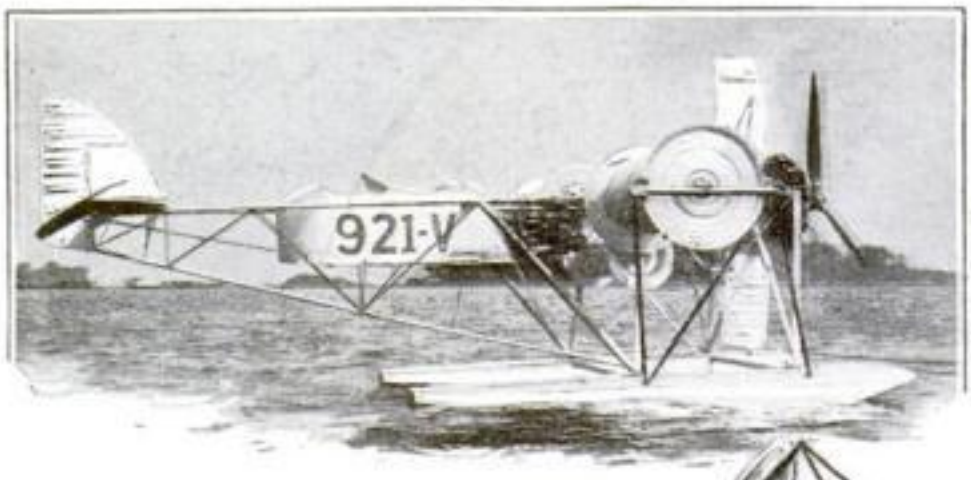
No horse but an Arab, for example, ever has been known to possess sufficient courage to face a lion or a tiger; all other mounts are useless in hunting them. That even the ancients knew this was proved not long ago when, in excavations at Nineveh, capital of the Assyrian Empire in Biblical days, were found bas-reliefs of men hunting lions armed with spears and mounted on horses of typical Arabian shape and size. Experts are certain these animals were the ancestors of the presentday Arab.

In this connection, horse lovers recall the story of the late Sir Robert Gillespie, British general, and his fearless Arab. One day Sir Robert attended a horse race at Calcutta during one of the great Hindu festivals, which are featured by all kinds of shows that attract huge throngs, when suddenly there was a commotion among the spectators. A tiger had escaped from its keepers. Sir Robert called for his horse and, snatching a boar spear from a near-by native, rode to attack the wild animal. When it saw him, it crouched, ready to spring. That instant the general leaped his horse over the tiger's back, striking the spear through his spine.

Unafraid of man or beast, yet docile and gentle, the Arabian horse has iron endurance, unexcelled speed, keen intelligence, and is supremely faithful. In the words of Ameen S. Zaytoun, an Arab, now of Philadelphia but formerly of the American consulate at Beirut, Turkey: "It will leap from a cliff to certain death at a soft spoken word from its master." It was Zaytoun, by the way, who guided the late Homer Davenport, the political cartoonist, on his tour of the Arabian desert which resulted in a large importation of horses and the conse- *(Continued on page 148)*

Whirling Spools Lift This Plane

New mystery airplane, built by three American inventors on barge in Long Island Sound, is tested in secret and is said to have made short flights.



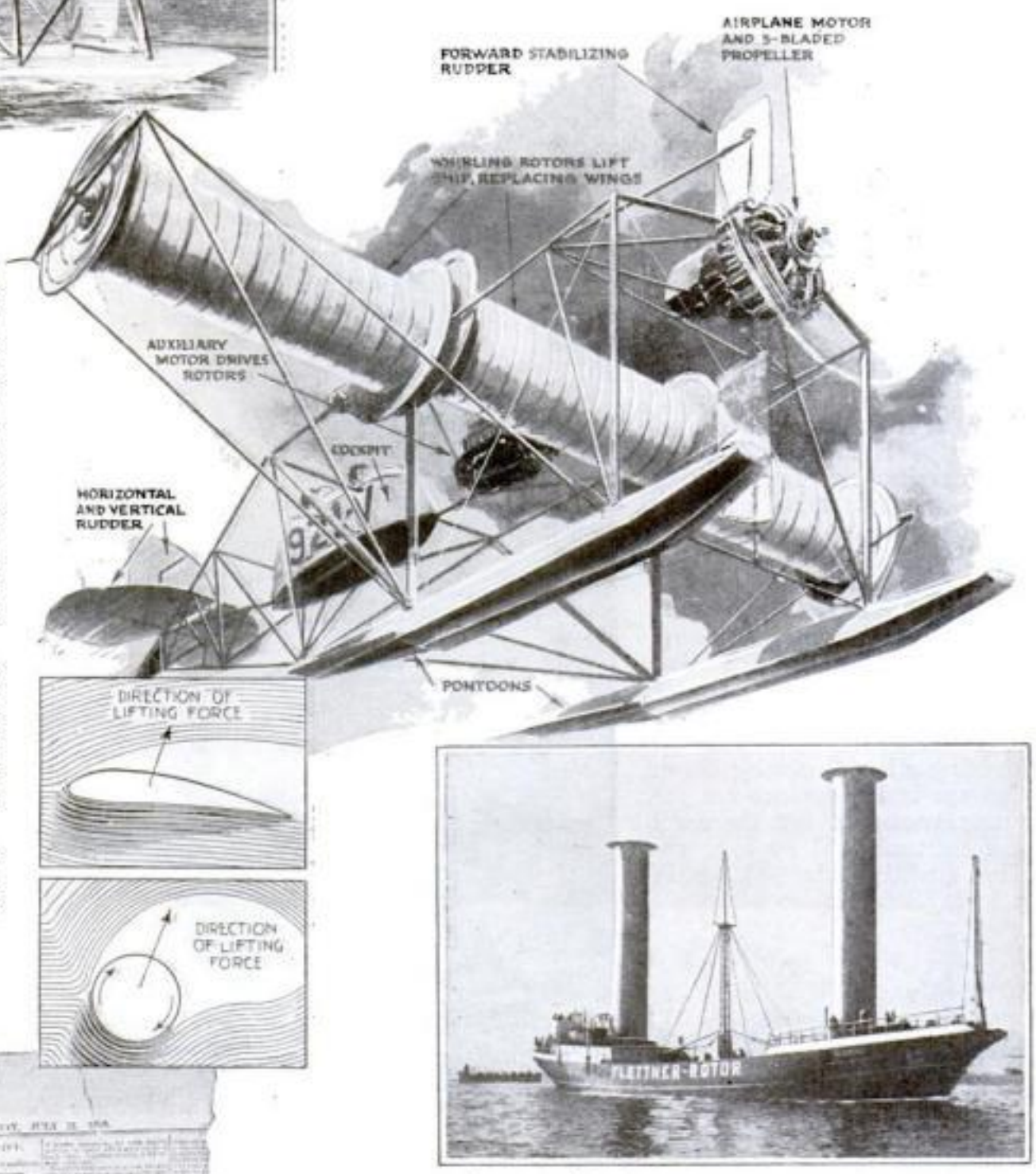
The mystery plane, modified by substitution of a new center rotor to improve its flying qualities, is here seen poised for a trial flight.

SPOOLS of metal, two feet thick, whirl on spindles to lift a strange new airplane without wings. The mystery craft, secretly being tested near Mamaroneck, N. Y., is reported to have made short flights over Long Island Sound. Its three inventors have isolated themselves and their machine on a barge until they are ready for a public demonstration.

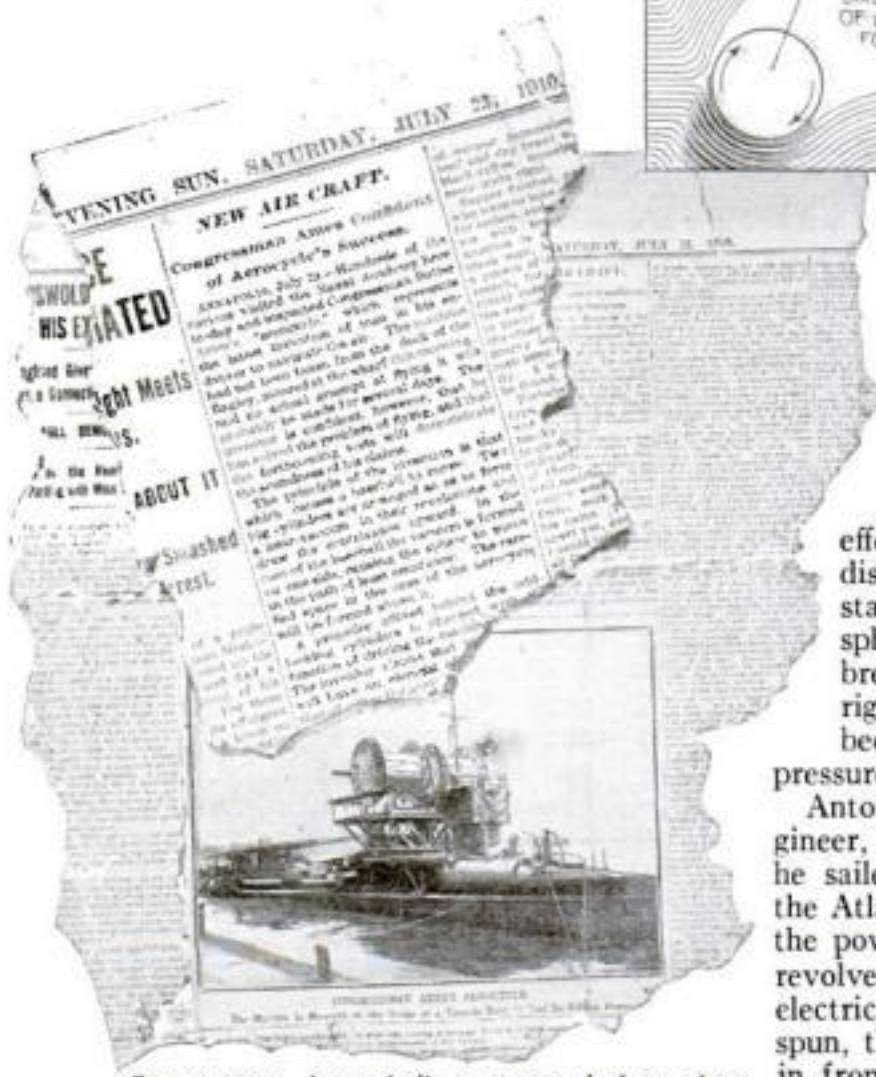
Their all-metal "rotor airplane" can lift ten times the load of any other plane of equal weight, they declare. They call it speedier than existing types, and, because of its smaller span, more economical to house.

Two motors drive it. A standard airplane engine and its three-bladed propeller pull the wingless craft forward. Meanwhile an auxiliary motor whirls the three spool-like cylinders. Upward pressure thus produced in a head-on breeze is the lifting force.

Though it seems radical in an airplane, there is nothing new about this principle. It is the same thing that makes a spinning baseball curve. Known since 1853 by the name of the "Magnus effect," after its German discoverer, it can be simply stated: A cylinder (or sphere) spinning in a breeze tends to move at right angles to the breeze because of the unbalanced pressure it creates.



At top, artist's idea of the rotor plane in flight based on inventor's original design. At left, showing how rotor lifts machine. Above, Flettner's rotor sailing ship.



Congressman Ames built a rotor airplane about seven years after the Wright brothers first flew.

Anton Flettner, German engineer, applied the idea when he sailed a "rotor ship" across the Atlantic to New York under the power of two tall cylinders, revolved in a crosswise wind by electric motors. When they spun, they whirled away the air in front of the stacks, lowering the pressure. By piling up air in the face of the breeze behind the stacks, they increased the pressure at this point. The combined effect of a partial vacuum in front and increased pressure in back was sufficient to propel the ship forward.

As long ago as 1910, a United States Congressman, Butler Ames, of Massachusetts, proposed to apply the same idea to aircraft. He even built a model and mounted it on a torpedo boat to test its lift. The rotors, turned to horizontal position, created vacuum above and pressure beneath in a breeze, just as does an airplane's wings. How they compare is shown in the small diagram, in which light areas indicate suction and the darkest show pressure; a breeze is assumed to be moving from left to right.

In 1924 the National Advisory Committee for Aeronautics studied rotor aircraft but evolved no practical machine.

Can Our Camera Fool Your Eye?

What's Wrong with the Pictures On the Next Two Pages?

$1,000 In Cash Prizes

Genial George Knowitall goes smiling from one mistake to another. You'll have a lot of fun checking up on him.

FIVE hundred dollars is a tidy little sum at any time. Here is a chance to earn it. Compete in this month's "What's Wrong?" Contest, and you may win the First Prize of $500. And if you are not that fortunate, you may carry off the Second Prize of $100, the Third Prize of $50, or one of the ten $10 or fifty $5 prizes.

This month again POPULAR SCIENCE MONTHLY is awarding sixty-three cash prizes, totaling $1,000, to the winners in the contest which began in the October issue and continues this month and in December and January.

On the following two pages you again will find four photographs showing incidents in the blundering career of Mr. George Knowitall. George has an idea he's a handy man. Although he probably couldn't put a good point on a pencil, he's always ready to tackle any little odd job that's around—and invariably succeeds in messing things up.

In each of the four pictures on the next two pages, George is doing a mechanical job, and in each case is doing it wrong. Aside from the mistake he is making, there are exactly four other errors in each picture, put there deliberately by our trick-photography man.

IT IS up to you to discover George's blunders and to find the four additional trick-photography errors in each of the four pictures. The prizes will be awarded to those contestants who find the errors and describe them in the clearest and most skillful manner.

Each monthly contest is complete in itself. If you participated last month, you may do so again, for there is no rule against your winning a prize in each of the four months of the Contest.

You don't have to be a subscriber or regular reader of POPULAR SCIENCE MONTHLY to take part in this Contest. You don't have to buy the magazine. And you are permitted to get all the help you need from anyone you wish. You may submit as many entries as you desire.

If this is your first try at one of the prizes, be sure to read the rules of the Contest on this page before starting work on the pictures. These rules are simple, but they will be strictly enforced. After reading the rules carefully, turn to the next two pages and try to win a prize.

Rules of the Contest—Read Carefully

1. Each month for four months, beginning with last month, POPULAR SCIENCE MONTHLY is printing four photographs depicting the adventures of George Knowitall. In each picture, Knowitall is doing some mechanical job in the wrong way. There are, in addition, four errors in each picture put there by trick photography. You are to tell us what George Knowitall is doing wrong and what the four photographic errors are in each of the pictures.

2. Prizes will be awarded to those persons who point out these errors most accurately, clearly, and skillfully. In case of ties, the full amount of the prize will be awarded to each tying contestant.

3. Answers to each monthly contest must be mailed or delivered to the offices of POPULAR SCIENCE MONTHLY not later than the thirtieth of the month following the date of publication of the magazine in which the pictures appear. Thus, to assure consideration in this month's contest, answers to the pictures in this month's issue, published October 2, must be mailed or delivered not later than November 30. No entry bearing a postmarked date later than the closing date for entry will be considered.

4. Answers may be submitted on any kind of paper, but they must be typewritten or written in ink, and on one side of the paper only. Each error must be listed separately and numbered. No changes or corrections will be allowed in any entry after submission, but any contestant may submit as many separate entries as he desires.

5. All entries should be addressed to the Picture Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York City. Name and address of the entrant must be written plainly on each page of the entry. Entries with insufficient postage will not be accepted. The publishers cannot be responsible for delay, loss, or nondelivery of entries. No contribution will be acknowledge and none returned. No inquiries regarding points covered in rules can be answered.

6. There is no entry fee. You need not buy POPULAR SCIENCE MONTHLY in order to compete. You can borrow a copy from a friend or you can examine one free of charge at any office of POPULAR SCIENCE MONTHLY or at the public libraries. Each contest is open to everybody, except employees of POPULAR SCIENCE MONTHLY and the POPULAR SCIENCE INSTITUTE and their families.

The officials of the POPULAR SCIENCE INSTITUTE will act as judges and their decision will be final.

PRIZES YOU MAY WIN IN THIS *NEW* CONTEST

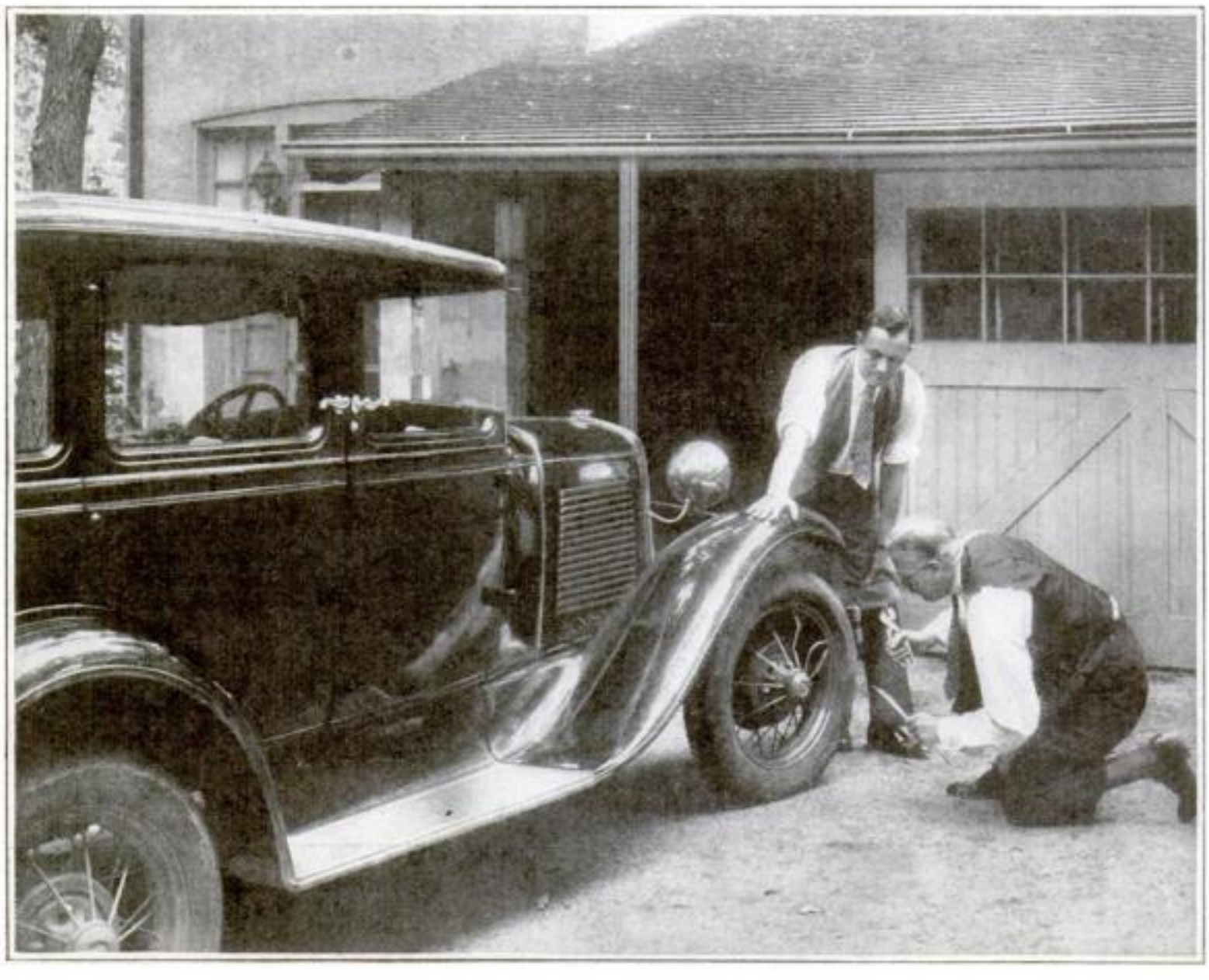
First Prize	$500
Second Prize	100
Third Prize	50
10 Prizes, $10 each	100
50 Prizes, $5 each	250
Total Monthly Prizes	$1,000

Another Contest Next Month—Watch for It!

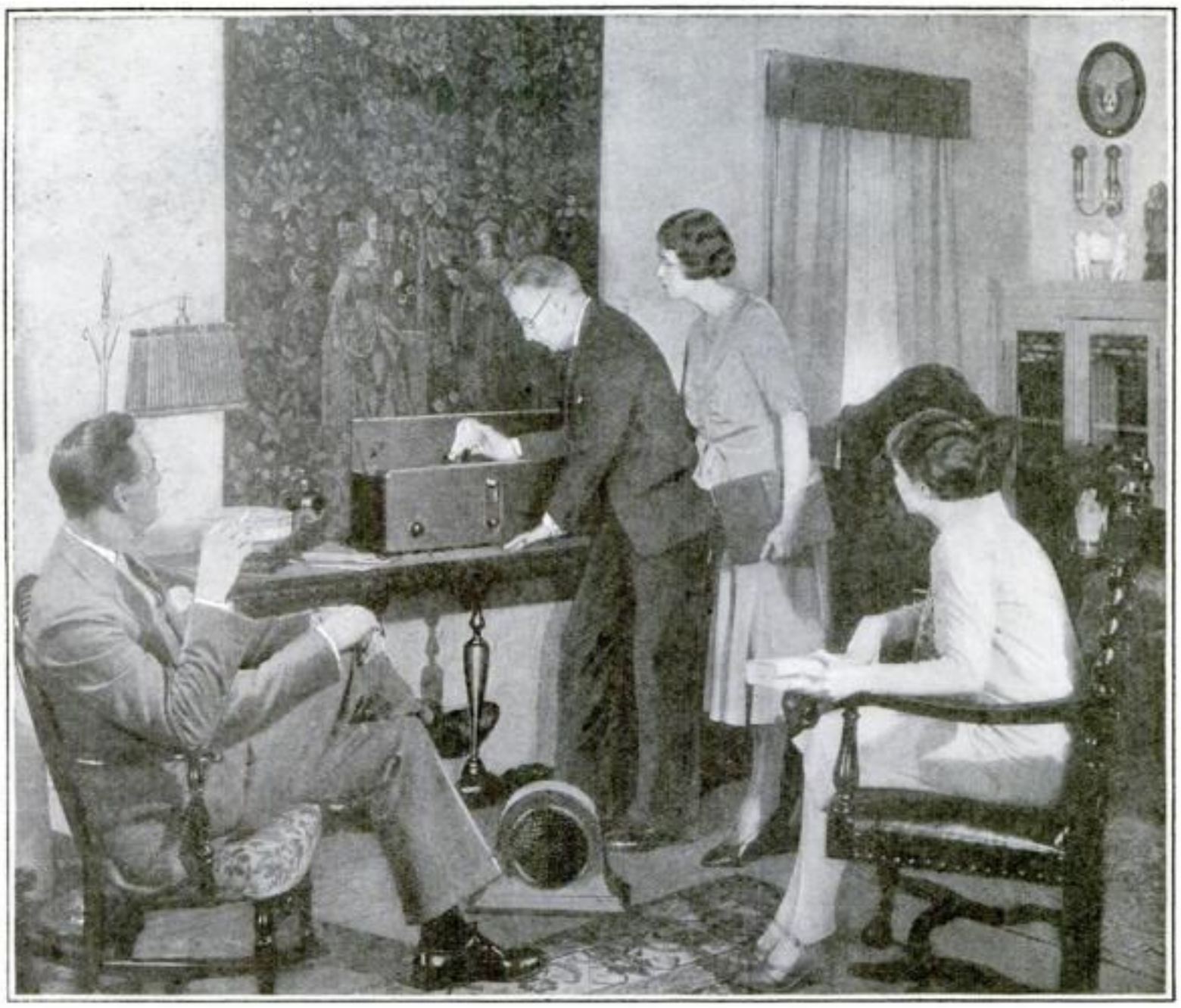
Find the Errors in the Photos; $1,000 in Prizes

In each picture on this page George Knowitall is doing a mechanical job in a wrong way and there are four errors deliberately put there by trick photography. Find the five mistakes in each picture, send us your answers, and one of the 63 cash prizes offered in this contest may be yours. All the errors are easy to see—if you are diligent and alert. Read the rules on page 27 and then try to win a cash prize.

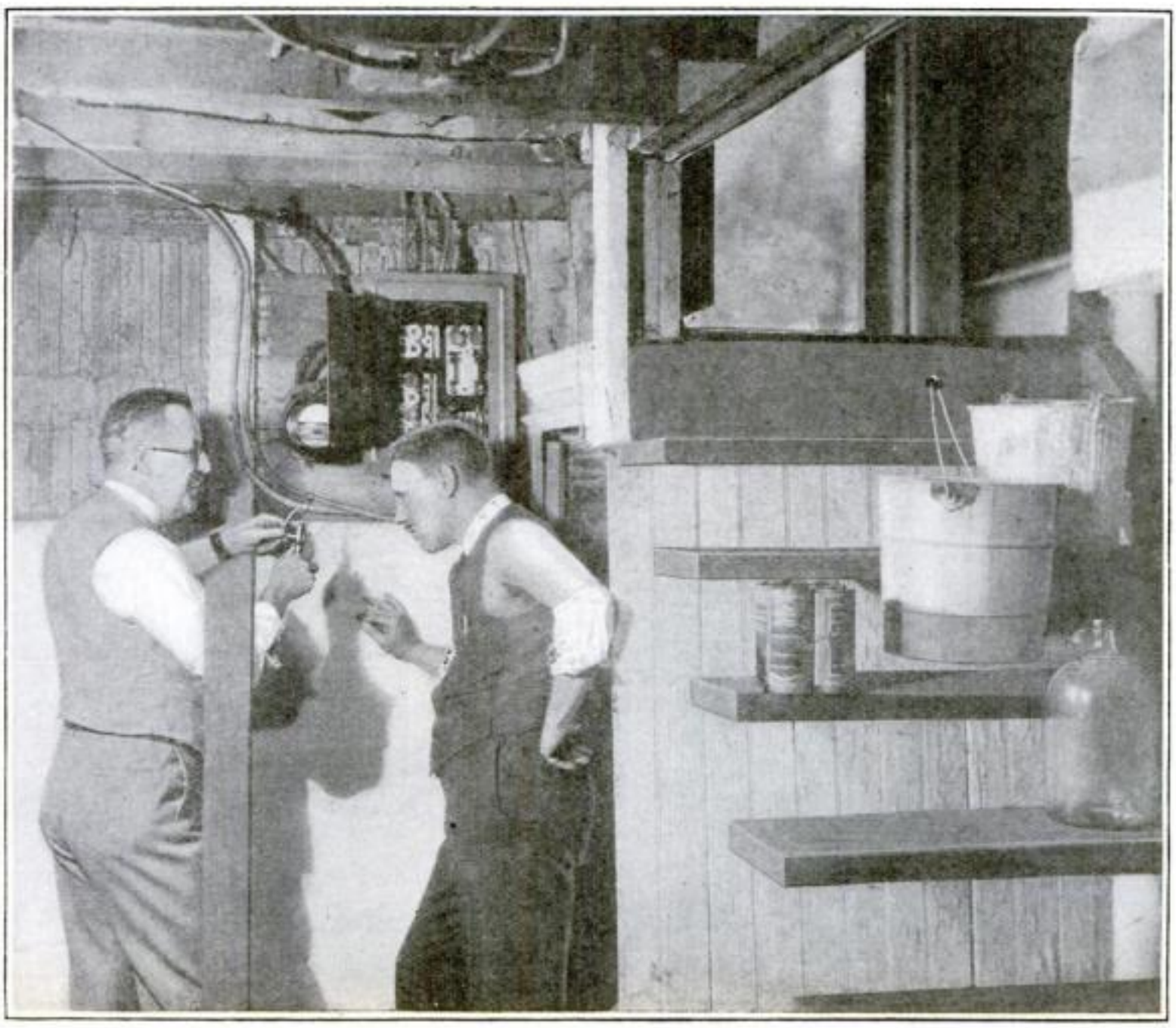
The ladies find gallant George Knowitall a willing helper. Here we see him fitting some hooks in the china closet so that the cups may be hung in orderly fashion. The lady is hanging them up as fast as he gets each hook in place. What is George doing wrong? Also find four other errors.



Knowitall's friend managed to hook the spokes in his Ford's front wheel on somebody's hubcap. Helpful George says that's a trifling trouble. He gets some wire and sets to work to cut out the bent and damaged spokes with a pair of wire cutting pliers. However, the confident smile on George's chubby face rapidly evaporates as he pursues the job with more energy than knowledge of what's what. Do you see what he is doing wrong? There are four more errors for you to find.



When the best program of the evening is suddenly interrupted by a burned-out tube in the radio set, our old pal George rushes to the rescue. Apparently he is spending a lot of time trying to put another tube in place of the one that won't light. His friends, who believed George when he said he was a radio expert, expect to hear music almost any moment. What is George doing wrong, and can you find the four other errors?

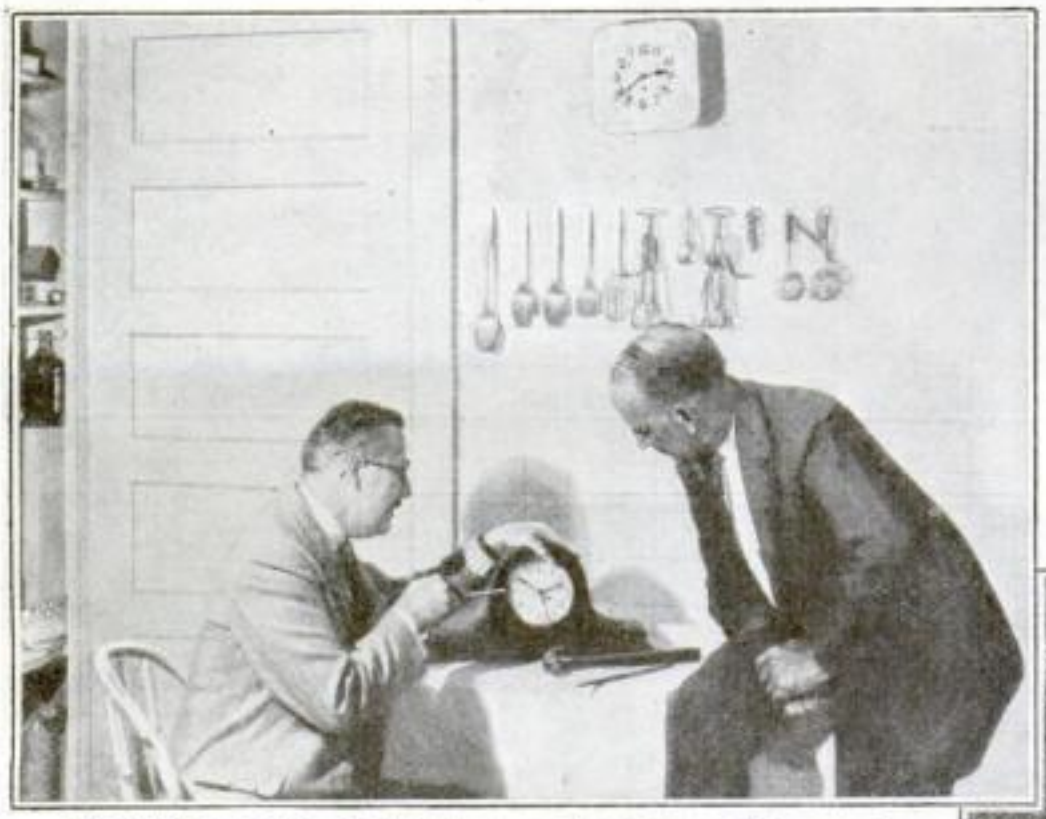


The doorbell didn't ring when Knowitall pushed the button, so he offered to fix it. After a search, he found the dead doorbell batteries, contemptuously discarded them, and then proceeded to show his friend the latest wrinkle—operating the bells from the light circuit. Here he is connecting the bell wires directly to the light wiring to complete the job. Is that right? And what are the four other errors?

$1,000 More for You to Share

There's Still Time to Enter Last Month's "What's Wrong?" Contest

WE ARE reproducing on this page in small size the four photos which made up the first chapter of our "What's Wrong?" contest. Read the rules on page 27, find the errors in these pictures, and send in your entry before October 30. The October issue, which can be examined free in public libraries, or at any office of this magazine, shows the pictures in larger size.



Friendly George Knowitall is always ready to try anything once if he thinks it will help someone in trouble. Here you see him busily engaged in regulating his neighbor's synchronous electric clock which he has found is several minutes slower than his watch. He is sure he will find the fast-slow lever somewhere back of the face dial.

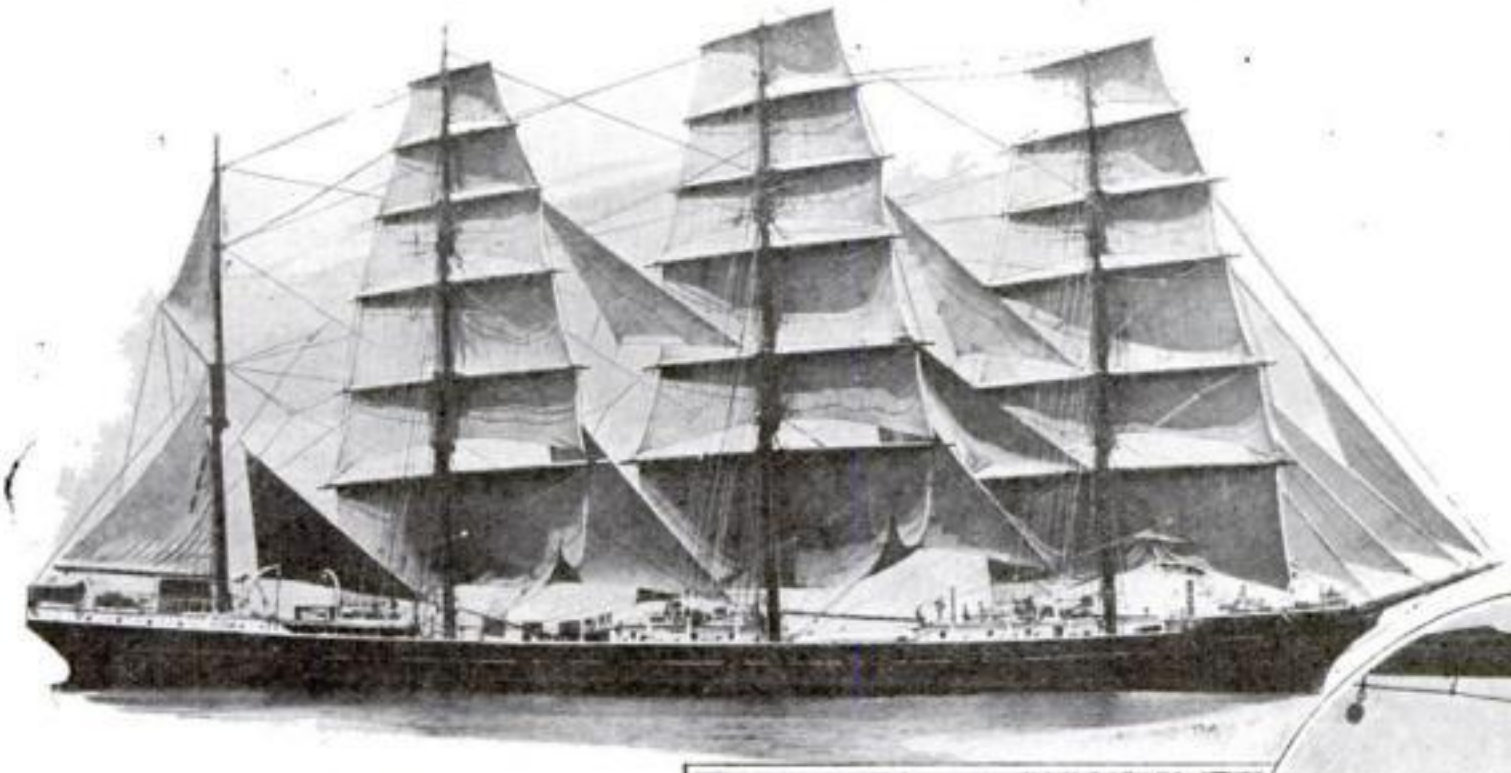
Fixing a puncture in a friend's tire is just child's play to kindly George—if he only knew how to do it. At any rate, he has taken the flat off and is attacking it with a tire iron confident that the job will take him only a few minutes. Do you think he is likely to succeed any time in the near future?

Good-natured George likes nothing better than fixing a leaky garden hose for his helpless young friends. Of course, he has no tire tape, but that doesn't give him a minute's concern. He goes at the job, as you see, in his own original way while his hosts are ready to help him—if they only knew what to do. Among them don't they seem to be getting the job pretty well snarled up? Can you see what's wrong and help them out?

Full of the best intentions in the world, George, at the left, is helping his cousins from the city plant flower seeds in the garden of their temporary country home. The delighted ladies expect the plants to grow and blossom in a few weeks. But with the approach of fall don't you think they may be disappointed?

Windjammer, with Training Crew, Lashed by Storm

Boys, learning to sail, get old-time thrill in Swedish bark as wind-driven waves crash poop deck and sails fly in ribbons—Boat is forced into Panama

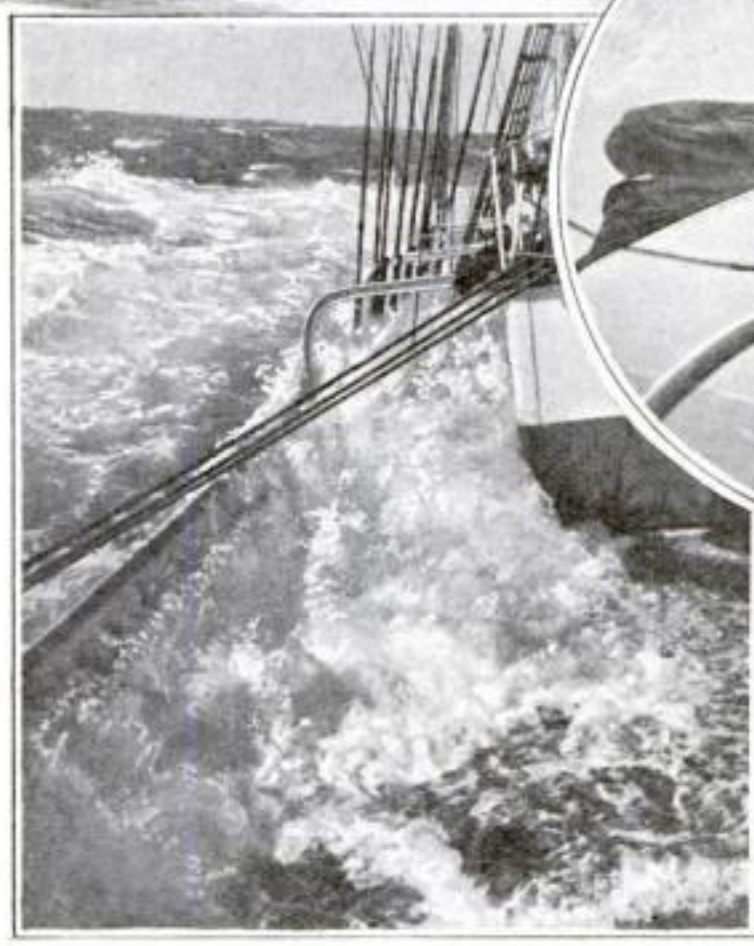


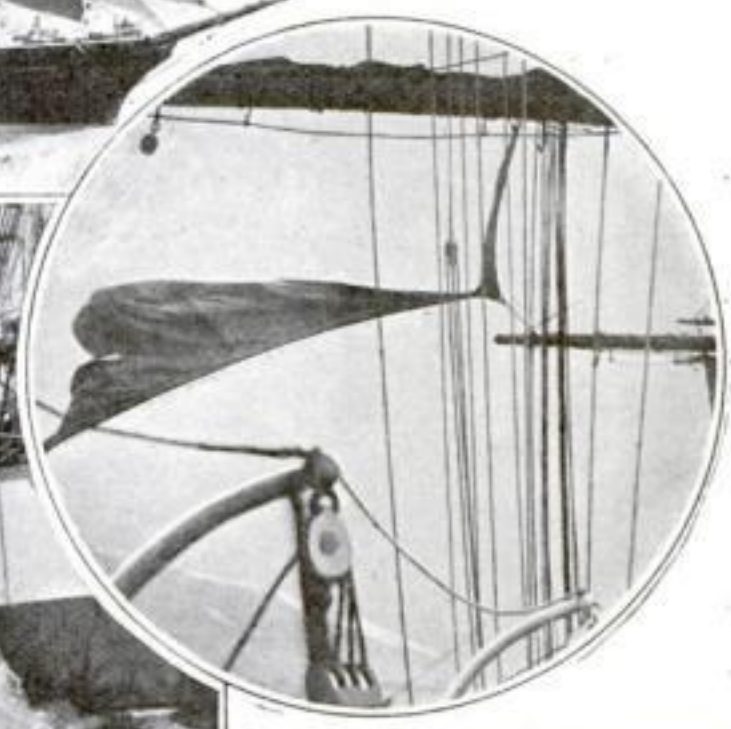
At left, the iron-hulled, square-rigged Swedish bark which, manned by a training crew, fought a wild storm in the Pacific and won it, thus recalling the old sailing days.

THE cook could fill his pots only one eighth full to keep them from splashing over, and the lifeboats were gone because a forty-foot wave had washed them overboard. Those were highlights of an iron sailing ship's recent trip across the Pacific in the "roaring fifties."

Contrary to popular impression, it will be many years before the more modern of the windjammers leave the seas for good. Today they serve as training ships where apprentices from sixteen to twenty-four years old learn seamanship and get a taste of the sailing thrills of an earlier age. Thus it was that the square-rigged Swedish bark *C. B. Pederson* put out not long ago from Port Phillip, Australia, bound for Queenstown, Ireland, with a cargo of 3,000 tons of wheat, an officer, one or two regular hands, and a group of apprentices. Eight weeks later, the bark put in at Panama with a main lower topsail torn to ribbons and a stove-in poop deck.

Cross seas caught the *Pederson* nine hundred miles off the South American coast, and hundreds of tons of water crashed upon the decks.

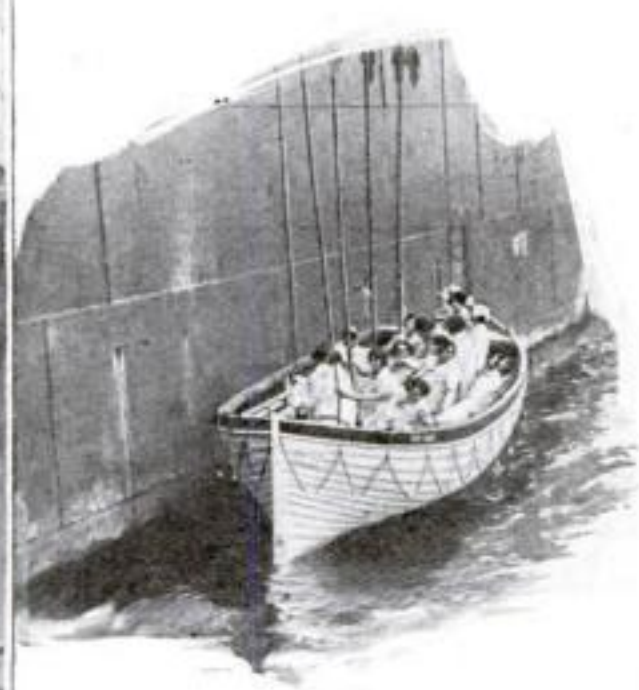




Above is shown all that remained of the main lower topsail, which was whipped to ribbons by the gale that hit the ship 900 miles off shore.

Hundreds of tons of water were hurled against the boat's deck by the force of the wind. Cabins were flooded, rails torn away, and the poop deck wrecked by huge waves.

ELECTRICITY LAUNCHES LIFEBOAT



Stewardesses on board the *Santa Barbara* worked the electric mechanism that lowered this lifeboat.

ELECTRICITY lowers the lifeboats aboard the *Santa Barbara,* modern New York-Chile liner. A group of stewardesses, in a recent demonstration at Brooklyn, N. Y., manned the lifeboats by themselves to show the ease with which boats could be put over the side. A control handle guided the loaded lifeboats while they slid down and landed safely in the water without the aid of a big launching crew.

MAN'S FIRST FINGER IS SHORTER THAN WOMAN'S

A WOMAN'S first finger is usually longer than her third, or ring finger. The first finger of a man's hand, however, generally is shorter than the third. This odd fact was confirmed recently by Ruggles George, of the University of Toronto, after examining 630 typical hands.

Turned out by high speed presses a hundred times faster than records have hitherto been made, a new flexible and unbreakable fiber record is now sold at news stands and drug stores.

These records can be bent almost double without harm. Here Vincent Lopez demonstrates this characteristic.

PHONOGRAPH RECORD IS LIGHT AND UNBREAKABLE

NEWS stands and drug stores are now distributing "unbreakable" phonograph records which recently were put on the market.

Made of red fiber paper, with a coating of a secret resin that carries the sound recording, the records are as light as cardboard, and so flexible that they may be folded nearly double without cracking. Toss one against a wall, and it flutters to the floor without damage. Hammering, scratching and wetting have no terrors for them. Their tone is said to compare favorably with that of any other record.

The material used to coat them was discovered accidentally during a search for a composition to be used in newspaper matrices. The records are stamped out a dozen at a time on high speed presses, one hundred times as fast as ordinary records are made, this mass production making possible the low price at which they sell.

PIANO, MANDOLIN, CELLO COMBINED WITH GUITAR

IT SOUNDS like an orchestra when De Main Wood, a Rochester, N. Y., music teacher, plays a tune. His remarkable instrument, he says, took him nearly half a lifetime to build and the other half to learn to play. It combines four pieces in one—guitar, piano, mandolin, and 'cello.

SPRING JAWS ON CLUB PICK UP GOLF BALL

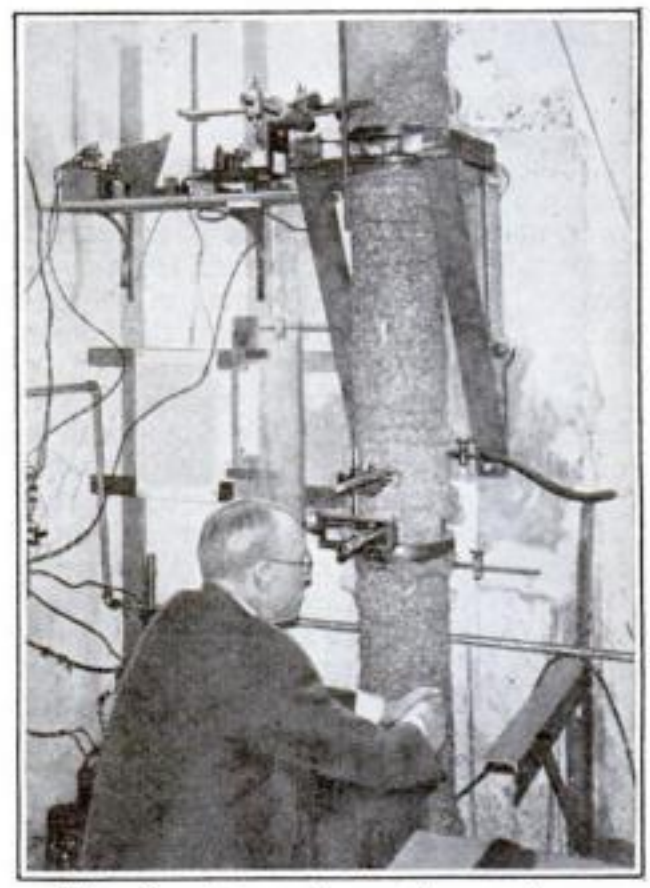
STOOPING over to pick up golf balls on miniature or full-sized courses is unnecessary for those who use a new device recently designed by a California inventor. This little contrivance consists of a simple metal cap that can be slipped over the end of the handle of a golf club. It is equipped with two spring jaws. When the end of the club is pressed down against a ball on the ground, the jaws spread and grasp the ball between them, holding it until it is pulled out by tne player. Attached to the end of the putter shaft, it saves the labor of bending down to retrieve the ball out of the cup. While this eliminates one reducing exercise, it is expected to appeal to most players.

These steel jaws, clamped to the end of your golf club, save trouble of bending for the ball.

SEEK POUND'S WEIGHT IN WASHINGTON, D. C.

How much does a pound weigh in Washington? That is not as foolish a question as it may sound, for a pound weight doesn't weigh exactly the same in every part of the earth. It weighs a little less than a pound, for example, on a high mountain top farther from the earth's center.

To find out just how much things weigh in Washington, D. C., tests are being made in a laboratory thirty-five feet underground at the U. S. Bureau of Standards. When they are completed, physicists and others to whom such tiny variations are of interest will have a strictly American standard. Formerly the only world standard was one measured in Germany, and measurements here were taken from that one, by means of elaborate mathematical correction.



Thirty-five feet underground, an observer watches a pendulum to get pound's weight.

BEES TELL TIME, BUT HOW NOBODY KNOWS

IF A BEE were to try a scheduled flight from New York to San Francisco, he probably could arrive within a second of the time at which he wanted to get there. This would not be fantastic in view of the recent discovery by Dr. Karl Frisch, of the Zoological Institute at Munich, Germany, of a remarkable "time sense" possessed by bees.

The accuracy of the time-telling mechanism within a bee's brain was tested by an ingenious experiment. Dishes of sugar and other attractive foods were set out at a certain hour each day. Bees that visited the miniature banquet were caught and marked with tiny spots of red paint. Each day new visitors were caught and removed, so that only a definite group of bees could acquire the habit of coming regularly to the meals. After a certain length of time, a timekeeper was stationed to record the arrivals of the bees. A large majority were found to arrive at almost precisely the time at which the food had been regularly set out.

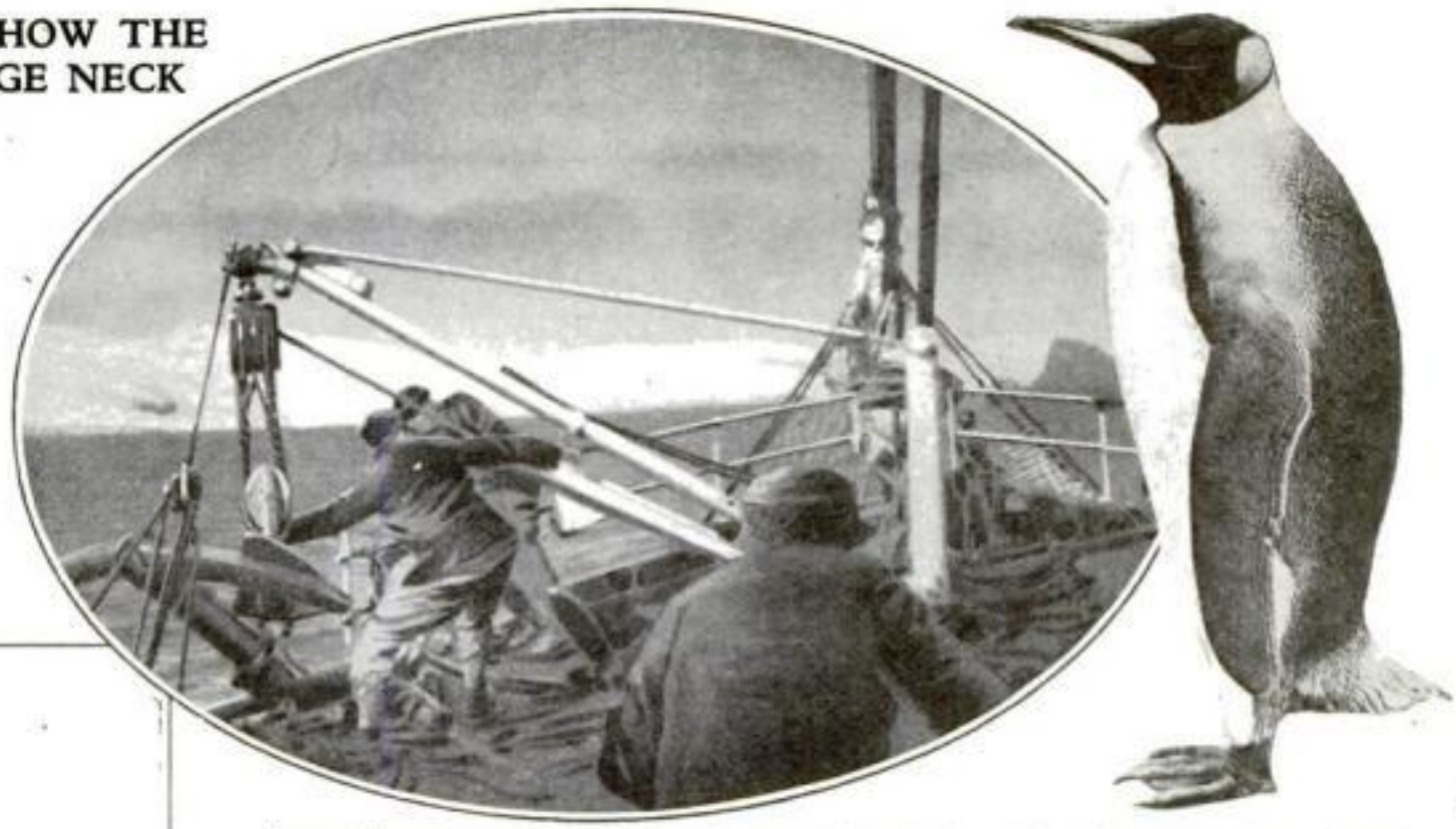
X-RAY PICTURES SHOW THE PENGUIN'S STRANGE NECK

X-RAYING penguins in the Antarctic was one of the feats of the recent expedition led by Sir Douglas Mawson. While Admiral Byrd's party was encamped on the side of that ice-covered continent within the Western Hemisphere, Mawson and his men went into the opposite side of Antarctica.

The explorers, turned zoologists, took advantage of the opportunity to obtain a complete set of X-ray photographs of the king penguin. The photographs were made by Capt. Frank Hurley, famous Australian explorer and photographer.

X-ray of penguin shows the remarkable development of neck, enabling bird to seize its food.

Like many humans, the penguin's prime interest is his diet. Hence the remarkable crook in his spine that gives him so flexible a neck. An unusually large digestive system provides him with plenty of fatty tissue to stand the rigors of the climate.



Approaching Antarctica, the home of the penguins. This striking view shows Mawson's ship, the *Discovery*, nearing Heard Island. At right, a king penguin of which X-ray photos were made.

HORSE'S LIFE STORY NOW COMPLETE

OUT of an Idaho bog hole came, the other day, one of the two principal "missing links" in the horse's ancestry. Dr. James W. Gidley, noted fossil hunter of the United States National Museum, uncovered the priceless cache of horse skeletons in the Snake River Valley. His discovery of certain skulls and bones connects the last of the horse's fossil ancestors, which had three toes, with the modern one-toed species.

This missing link skull was found by Dr. J. W. Gidley. It completes the horse's family tree back to an age before human life appeared and is final connection between today's one-toed horse and its three-toed ancestor.

The oldest human families might now envy the horse his family tree, for Doctor Gidley's discovery gives him a clear genealogy back to a time before man's first appearance upon the earth. His find vindicated a scientific prediction, for it shows the horse evolved just as theorists claimed it did. The only remaining "missing link" occurs far earlier in the horse's history, so that it is of less importance in recent geological history.

The horse's first known ancestor, called the "dawn horse," was a graceful little creature no larger than a cat. It lived in America millions of years ago. From this animal to the present day, five definite types are known. With each succeeding epoch the horse gained in size, and the number of its toes diminished, until the species now living appeared.

BOAT RUNS WITHOUT A CREW

With nobody on board, this motorboat was maneuvered by radio at Portsmouth, England. It may be used as a war boat when loaded with explosives and directed against the fleet of an enemy.

BATTLESHIPS and destroyers rested at their moorings during a recent exhibition at Portsmouth, England, while the British navy's oddest craft walked away with the show. This diminutive thirty-five-foot motorboat, without a man aboard, chugged across the harbor, turned, and maneuvered as if an unseen hand were at the helm. Only four small radio masts gave spectators a clue as to the working of the mystery boat.

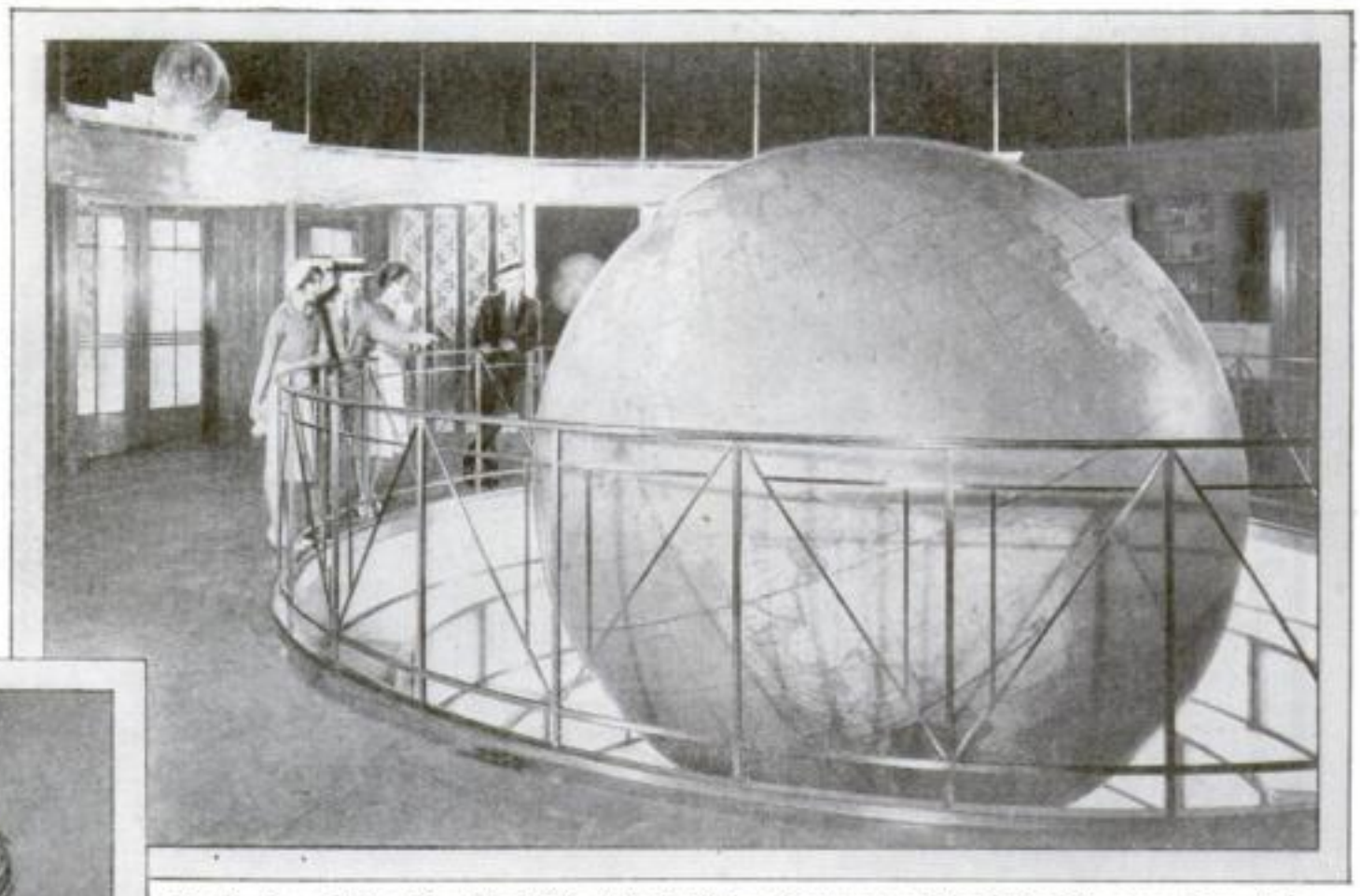
Actually the craft's self-operating machinery was guided and controlled by radio impulses from a distant sending station. It is not the first time that a vehicle has been operated in this way; airplanes, automobiles, and tanks have been so controlled.

TWO-TON EARTH SPINS IN NEW YORK OFFICE BUILDING

A TWO-TON "earth" spins in the lobby of a New York City office building. With its recent completion, it became the center of a unique astronomical exhibit for which the structure was especially planned.

The miniature earth, in a lighted pit, revolves once in ten minutes. A "sun" shines down upon it, also, from the black glass dome of the lobby, four stories high.

Making the big globe presented unusual problems. A curved ladder, for example, had to be built in order to allow artists to paint on the lettering.



Resting in a pit in a New York City office building, this two-ton globe, lighted by a sun four stories above it, makes one complete revolution every ten minutes. Panels on the walls show phases of the moon.

Specially constructed circular ladders were needed to put the lettering on this big earth.

POPULATION, SINCE 1920, JUMPS 17,000,000

THE United States is still far from crowded, but it's coming along. Practically complete returns from the 1930 census show that there are more than 122,700,000 of us now. This is an increase of seventeen million since the last official census, in 1920. If all the land in the United States were divided equally among its citizens, each of them would have about fifteen acres.

WOMEN TALK EASIER—THEREFORE MORE

WOMEN'S vocal cords are lighter and move more easily than those of men. That, according to two German physiologists, explains how women have acquired the reputation of being the talking sex. The truth of the matter is that it is simply less effort for them to be vocal.

CHEMISTS MAKE RUBBER PLEASANT TO SMELL

SUBSTANCES such as rubber and kerosene, considered among the most unpleasant of common smelly things, are now made easier to sell by adding another odor to them in the form of an "industrial aromatic." Although this substance may sometimes be equally bad-smelling, the combination produces a pleasant odor.

Chemists of industrial concerns are learning to convert ill-smelling substances into pleasant ones. For example, Dr. Eric C. Kunz, of Montclair, N. J., recently found four aromatic substances that will improve the aroma of artificial leather.

MACHINE KEEPS ROAD BUILDERS HONEST

WHETHER a contractor gives a city its money's worth when he lays a new street pavement is speedily determined by a testing machine recently introduced in Cincinnati, Ohio.

Ten or twelve days after the contractor finishes a street, a small truck drives up, and a core drill mounted on it and driven by a four-cylinder motor whirs into the pavement. In a few minutes it brings up a cylindrical sample showing clearly the successive layers of concrete and asphalt that the contractor has laid. Such samples, taken at fifty-foot intervals along the street, are hurried to the municipal laboratory, where engineers find out just what kind of a pavement the contractor has put down.

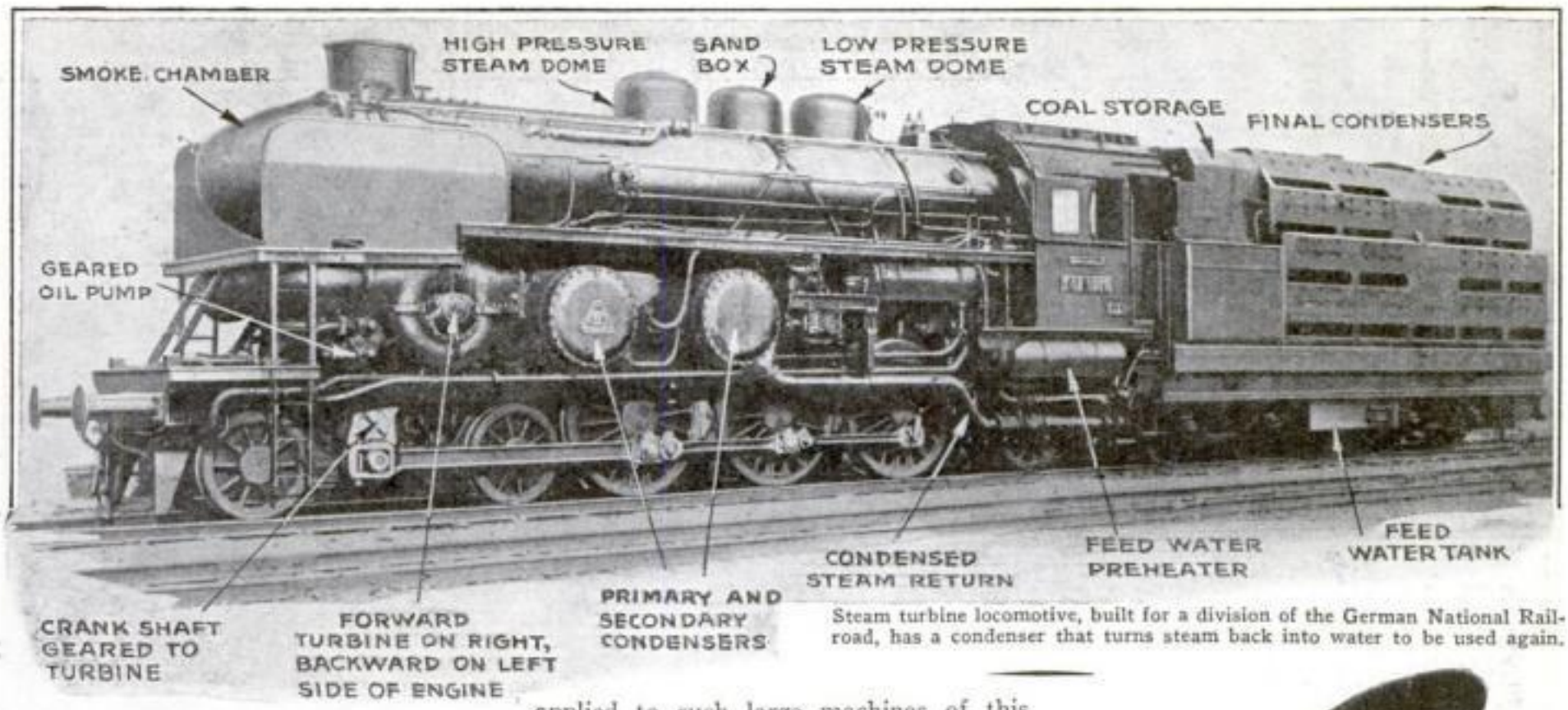
As the sample constitutes a cross-section of the entire depth of the roadbed, it is obviously impossible for the contractor to skimp any one layer, by making it thinner or cheaper than called for, and escape detection. Without connivance with officials, honest work becomes his only insurance.

When the tests are completed, plugs are molded to the right size and replaced in the holes made in the street by the sampling.

By averaging the results from testing a number of samples, municipal authorities obtain information that no one can dispute.

A core drill, motor-driven, takes a sample of pavement, like the one in circle above to the left, to check work of contractor building the road.

NEW STEAM TURBINE FORTY PERCENT MORE EFFICIENT



Steam turbine locomotive, built for a division of the German National Railroad, has a condenser that turns steam back into water to be used again.

A STEAM turbine locomotive of unusual design has just been completed in Germany by the famous Krupp Works for duty on the Hanover-Cologne division of the German National Railroad.

By the use of two turbines, one to drive the locomotive forward and the other to drive it backward, coupled with suitable reduction gearing to a crank shaft, the inherent disadvantages of high speed turbine operation have been overcome.

The turbines exhaust steam directly into a series of condensers which, by reducing the back pressure, make the available steam pressure more effective. A series of tests show the new turbine locomotive to be about forty percent more efficient than ordinary reciprocating engine types.

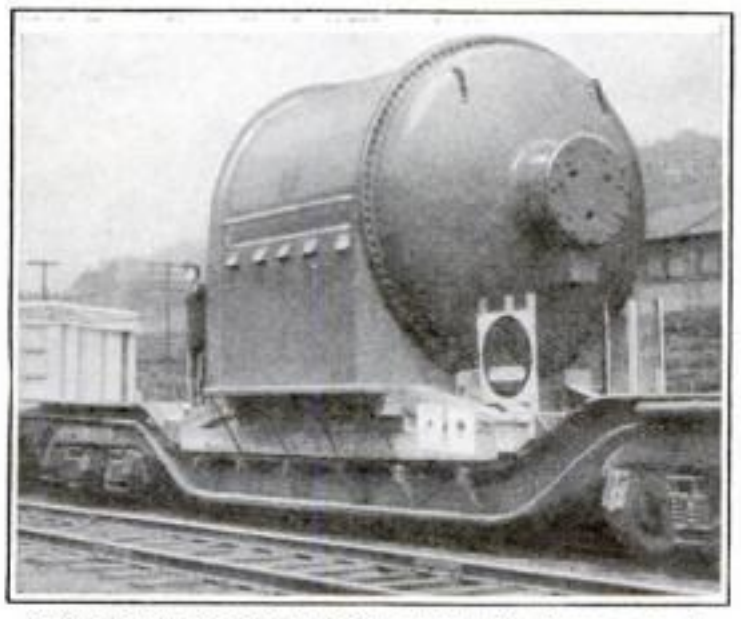
The efficient condenser system which makes it possible to use the water over and over and thus eliminate boiler scale is responsible for most of this added efficiency. The remainder is due to advantages of the high speed steam turbine.

BIG MACHINE RUNS IN HYDROGEN GAS TANK

FILLING balloons is not the only thing that hydrogen, lightest of gases, is good for. Recently a car left East Pittsburgh, Pa., bearing a huge electric machine that is inclosed by a tank of water-cooled hydrogen gas.

This machine, a rotating device known as a "synchronous condenser," which handles as much as 20,000 horsepower of electric energy, was built by the Westinghouse Electric and Manufacturing Company to improve the quality of electric distribution over transmission lines of the Southern California Edison Company. An even larger one of 67,000 horsepower rating is being constructed by General Electric Company engineers with hydrogen cooling also.

Although hydrogen cooling has been used successfully for some time, it has never before been applied to such large machines of this type. The advantages are unusual. Since hydrogen is less dense than air, a rotor spinning in the gas encounters less frictional resistance. Corona or "brush" discharge of static electricity is practically eliminated. Because of these factors, hydrogen cooling increases such a machine's output by a fourth or more. There is even less danger of fire than with a machine running in air, since hydrogen by itself does not support combustion.



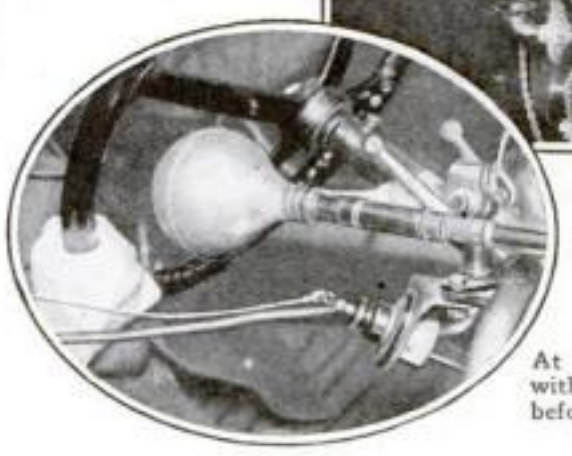
This big machine, inclosed in a tank of hydrogen gas, is on its way west loaded on a specially built freight car.

PUSH BUTTON STARTS ENGLISH FIRE ENGINE

THE FIRE fighters of Burton-on-Trent, England, have designed a device that speeds them on their job. When a fire call is received at the station, the pushing of a button rings a bell for the firemen, starts the motor of the fire engine, and opens the doors of the fire house.

As the vehicle leaves the station house on its way to the fire, the alarm is automatically shut off.

Pushing this button in a fire house in Burton-on-Trent, England, rings bell, starts motors, opens door.



At left the cable, connected with automatic starter, is seen before it is pulled from socket.

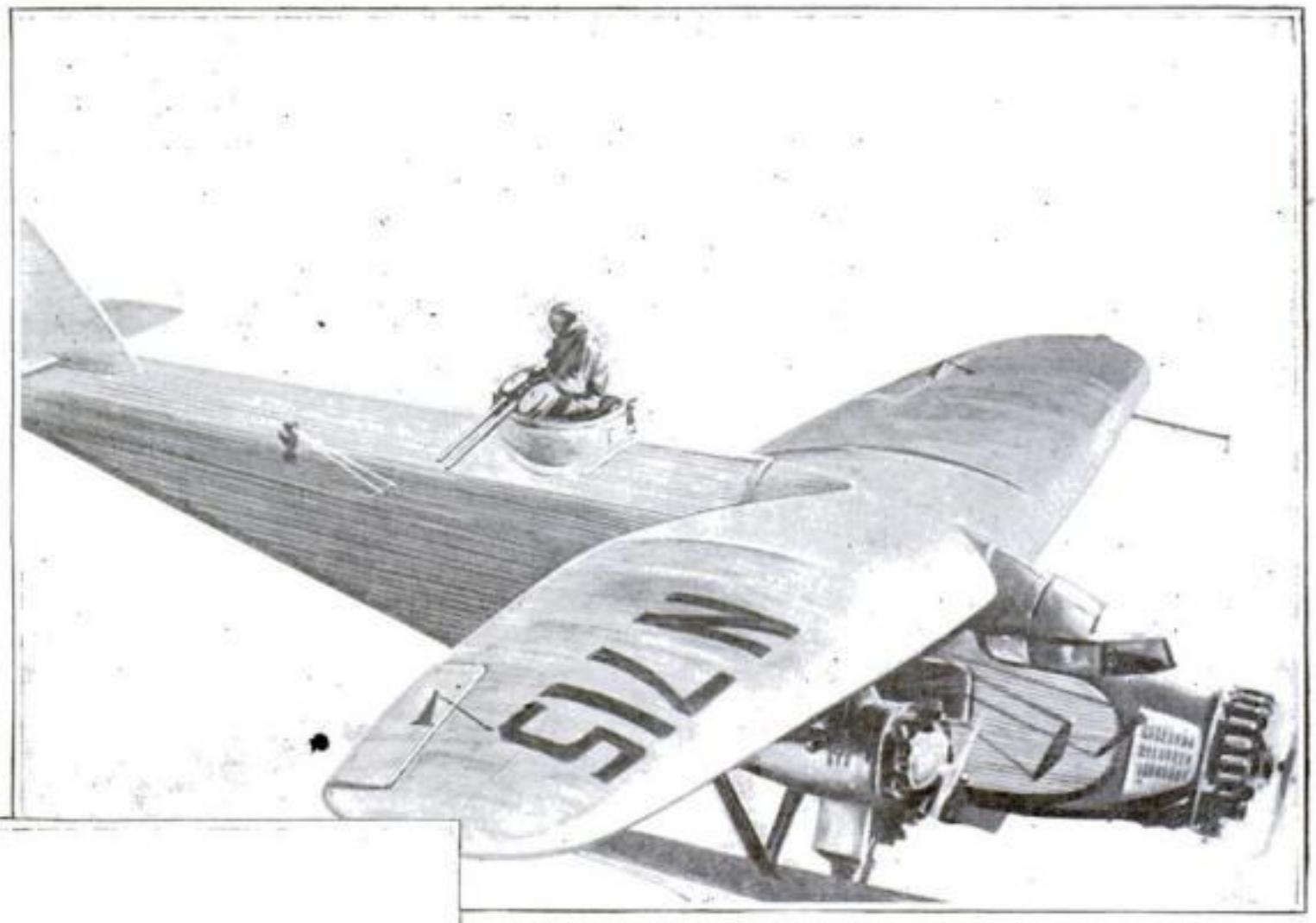
MAKES CONCRETE THAT RISES LIKE BREAD

A CONCRETE building material that "rises" like bread in the oven, to attain a fluffy lightness weighing only a fraction as much as ordinary concrete, has now been successfully applied for the first time. A steel mill at Bethlehem, Pa., has laid floors of it and it has also been used in a New York City building.

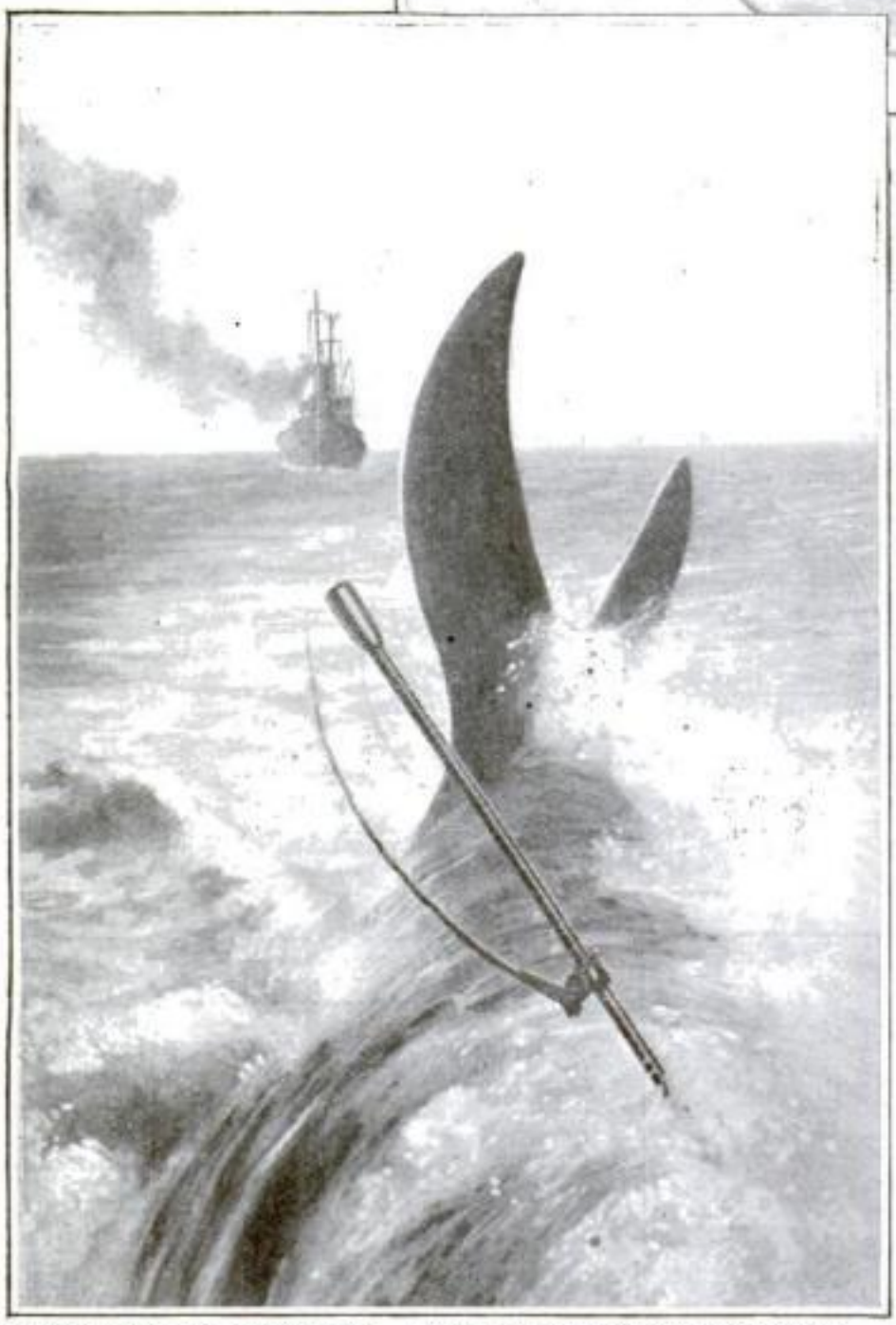
A Swedish discovery, the material is made by a chemical reaction that fills it with bubbles of the same gas that makes bread rise. Introduced in this country two years ago, it has just passed severe engineering tests at Columbia University. They showed it so strong that a weight of 370 pounds on one square inch left no impression.

Whales Pursued in Planes Are Shot from the Air

CARELESS slaughter so thinned the ranks of the giants of the sea and made the whales so cautious that new ways of hunting them had to be found. The latest weapon of the whaler is the airplane. These remarkable pictures show how whales now are pursued and killed in the rich whaling waters in the neighborhood of Cape Horn.



DEATH OUT OF THE AIR. Flying close to the water, a machine gunner in an airplane ends the whale's final struggles with a rain of bullets. The dead animal is then towed to the ship and swiftly dismembered. Formerly the killing of a whale and cutting it up was a long drawn out affair, but with modern methods the work is finished off in a few hours.



FIGHTING FOR ITS LIFE. After the harpoon has been driven home the whale starts a fierce and desperate struggle to escape. A rope, long enough to give him freedom of movement, is attached to the ship. When death comes, the animal is dragged alongside to be cut up.

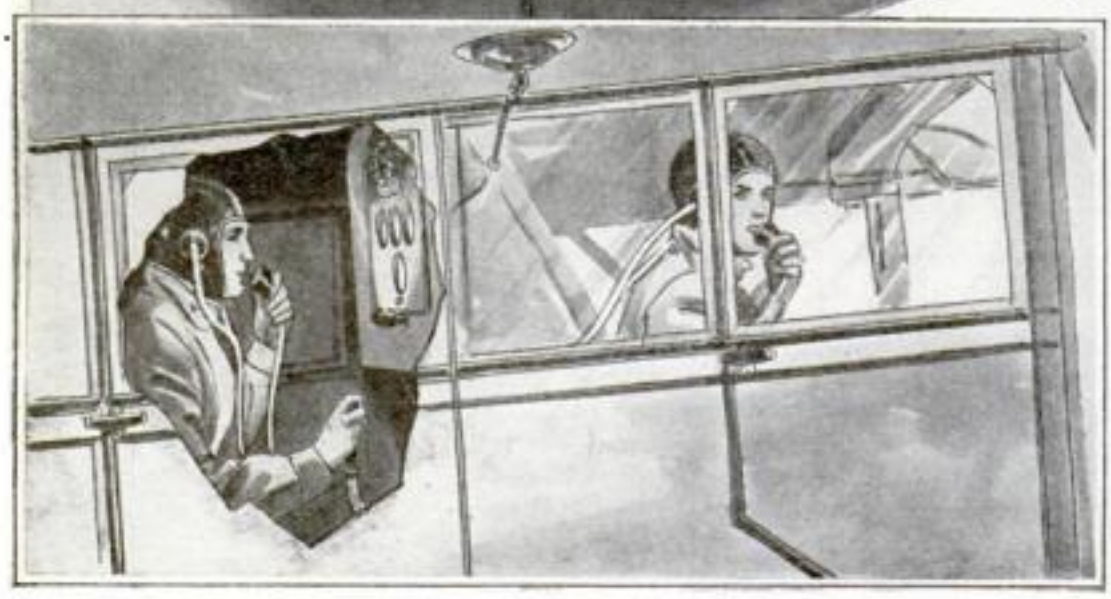
HARPOONER ALWAYS SAFE. Standing securely on the deck of the whaling vessel, the man at the gun fires a torpedolike harpoon at the whale. As the harpoon strikes, a blast explodes inside the animal.

LOOKING FOR WHALES. The crow's nest is in an airplane now and the search for the mighty mammals is carried on by flyers who rise from the mother ship and scour the waters for spouting whales. Schools of them can be seen at a great distance by the lookout in a plane. When the animals are sighted a warning is sent to the ship by wireless.

UP FOR ANOTHER BREATH. As the whale, harpooned but still fighting, rises for air so that he can continue his struggle, the man who fired the fatal shot leans over the rail and watches the desperate creature gather strength for one last effort.

SIGHTED FROM THE AIR. Flying high over the waters, a whale is seen by the flying lookout as it rises for air. From the old crow's nest the field of vision was limited, but from a plane a great expanse of water is visible and as a result whales are more easily found and dispatched.

At left, Jordanoff in the instructor's cockpit of "Blind Robin," and below, drawing shows student in dark room at the controls. The speaking tubes and ear phones for communication during two-way flight can be seen in use.



An instrument board in plane equipped for blind flying. Dials are mounted so hands make straight lines across panel.

Blind Flying— A Race Against Death *with only* Dials to Guide You

By ASSEN JORDANOFF

SWEEPING a hundred miles an hour through white, blinding fog. Straining every nerve for the unexpected. Gambling your life on the accuracy of a dozen dials. That is blind flying. It is a chancy business that no pilot enjoys.

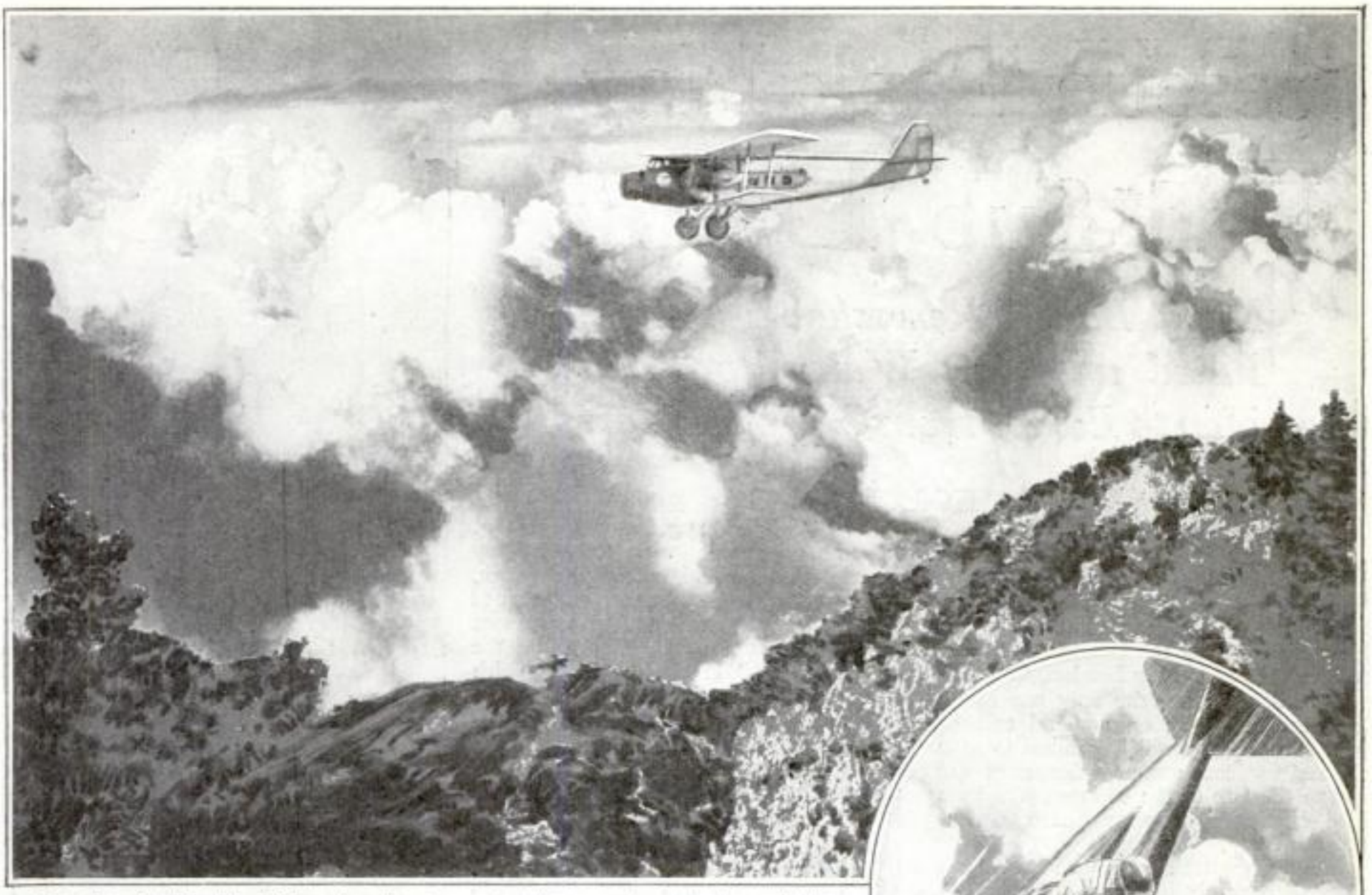
My first taste of blind flying was a thrilling "fog-take-off" during the World War when I was flying Fokkers on the Saloniki Front with the Bulgarian "war birds." Our field lay in a valley between two mountains. Each morning a thick layer of ground mist hung over it. An hour or so after sunrise the mist would disappear and we would begin our patrol. But one morning we were tumbled out of bed early. Groping our way to the starting line we found the ships warming up in the murky light.

A Farman bomber was reported coming across the lines. We were ordered to attack. One by one we taxied to the far end of the field. The heavier fog floated ten or fifteen feet above the ground. We roared the full length of the runway, only a foot or two above the earth, to gain excess speed. Then we pulled back the sticks, zoomed into the 200-foot blanket of fog, and burst out into the clear air above like rockets. By the time we returned from chasing the Farman home the mist had cleared.

Of course, a twenty-second zoom through ground mist is a long way from modern blind flying. But in those early days we had practically none of the instruments which make present-day fog flights possible.

Seven years ago, I climbed an old "Jenny" biplane with a ninety-horsepower motor over Curtiss Field, Long Island, through 2,000 feet of cloud-fog with nothing but a tachometer, showing the number of engine revolutions, on the instrument panel to guide me! During the war, students were taught to depend upon this instrument for various information. With the throttle open, a motor makes a certain number of revolutions a minute in level flight. When the nose is pointed up, giving more work to the engine, the number of the "revs" drops down. The steeper the climb, the greater the drop in revolutions. Thus, a pilot can estimate his climbing angle by watching his tachometer.

On this flight, I got clear to the top of the cloud blanket, which began at 1,500 feet and ended at 2,500 feet, then lost my balance and had to dive down through again. It is a curious thing that the point where a pilot begins to emerge from fog or a cloud is the place where he is most likely to lose his sense of balance. Probably the contrast of the light at the cloud



In a plane fitted for blind flying, the pilot steers a straight course through a heavy blanket of fog if he finds the ceiling is too low to permit safe flying beneath the dense clouds.

fringe with the darkness of the interior makes a pilot think he can see better than he can and causes errors in judgment. In instrument flying, the pilot should keep his eyes set on the dials until he is entirely out of the fog or clouds.

RECENTLY, I did some special work in blind flying instruction at the Curtiss school, Valley Stream, Long Island. We have a Robin monoplane fitted up with the rear compartment covered so the occupant cannot see. The instructor sits in front and the student occupies the "dark room" behind to practice blind flying. The two can converse back and forth through a system of speaking tubes.

Such machines are being added to the equipment of many schools. The famous Army school at Kelly Field, Texas, where Lindbergh learned to fly, now teaches instrument flying to cadets as part of the regular course. On the cockpit panels of practically every modern plane are all the indicators necessary for fog piloting. A present-day flyer who is not trained to fly blind is only half trained.

When a student climbs into the "dark room" compartment of "The Blind Robin," he faces six radium-dialed instruments. The air-speed indicator gives the number of miles an hour the machine is passing through the air. The tachometer shows how the motor is functioning. The rate of climb indicator tells whether the ship is ascending or descending and how fast. The compass gives direction. The altimeter shows the height of the plane above its take-off point. The bank and turn indicator informs the flyer whether his wings are level and if he is turning from a straight course. These are the necessary blind flying instruments. Mail planes, however, are often equipped with a score of additional gadgets to help the pilot fly in all sorts of weather.

Out of fuel and whirling down through a fog bank, a pilot has no choice but to take to his parachute.

The latest instrument boards, one of which is shown in the illustration on the opposite page, are so arranged that the hands of the main dials point toward each other in straight lines. When the pointers are all lined up, the pilot knows that he is flying under normal conditions in reference to speed, height, and so on. If one hand moves and breaks the line, the pilot can easily see it. This is important, as it keeps the flyer from concentrating on one part of the instrument panel and losing sight of the dials on another part.

Courtesy Sperry Gyroscope Company

Artificial horizon pointed out by Ruth Nichols as Clarence Chamberlin, upper left, Elmer A. Sperry, Jr., left, and P. R. Bassett look on.

THAT is what I did two or three years ago on my first long blind flight between Toledo, Ohio, and Chicago, Illinois. I was ferrying through a Fairchild-Whirlwind cabin monoplane. Out of Toledo, I hit rain squalls, then fog. The ship was fully equipped for blind flying. So I decided to drive through. For an hour, I concentrated on the dials ahead of me, hardly able to see the wing tips of the plane. In such flying, the most important instrument on board is the bank and turn indicator. In the rough air, I riveted my attention on it. I was flying at 1,900 feet.

Suddenly, [*Continued on page 151*]

Rescue Tank May End Sub Deaths

Navy Builds Remarkable Tower, Filled with Sea Water, to Train Men to Escape from Crippled Craft

By JOHN E. LODGE

IMAGINE a silver lighthouse, equaling a thirteen-story building in height, eighteen feet in diameter, and filled with sea water, and you have a fair picture of the "rescue tower" that has just been completed at the United States submarine base near New London, Conn.

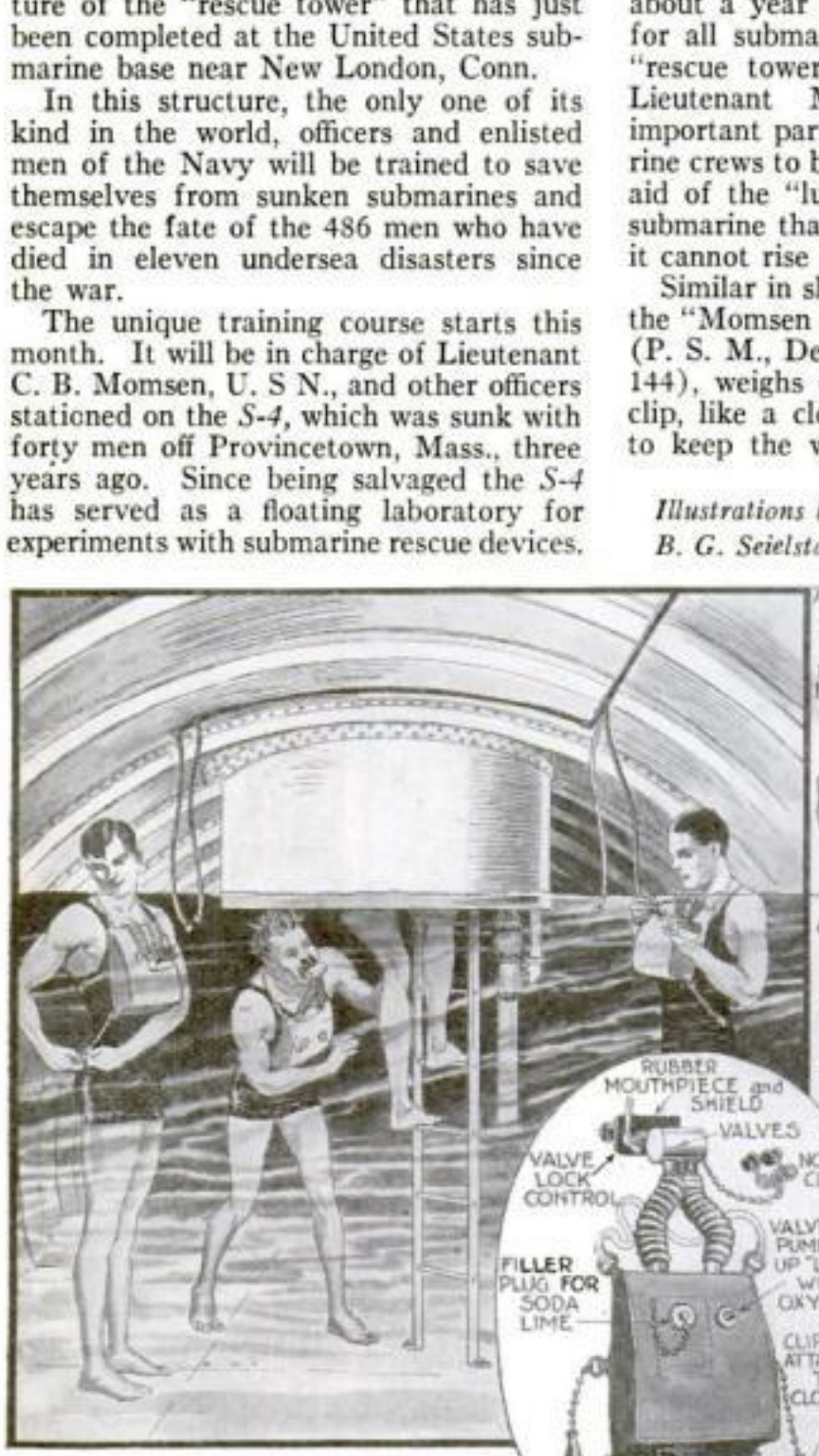
In this structure, the only one of its kind in the world, officers and enlisted men of the Navy will be trained to save themselves from sunken submarines and escape the fate of the 486 men who have died in eleven undersea disasters since the war.

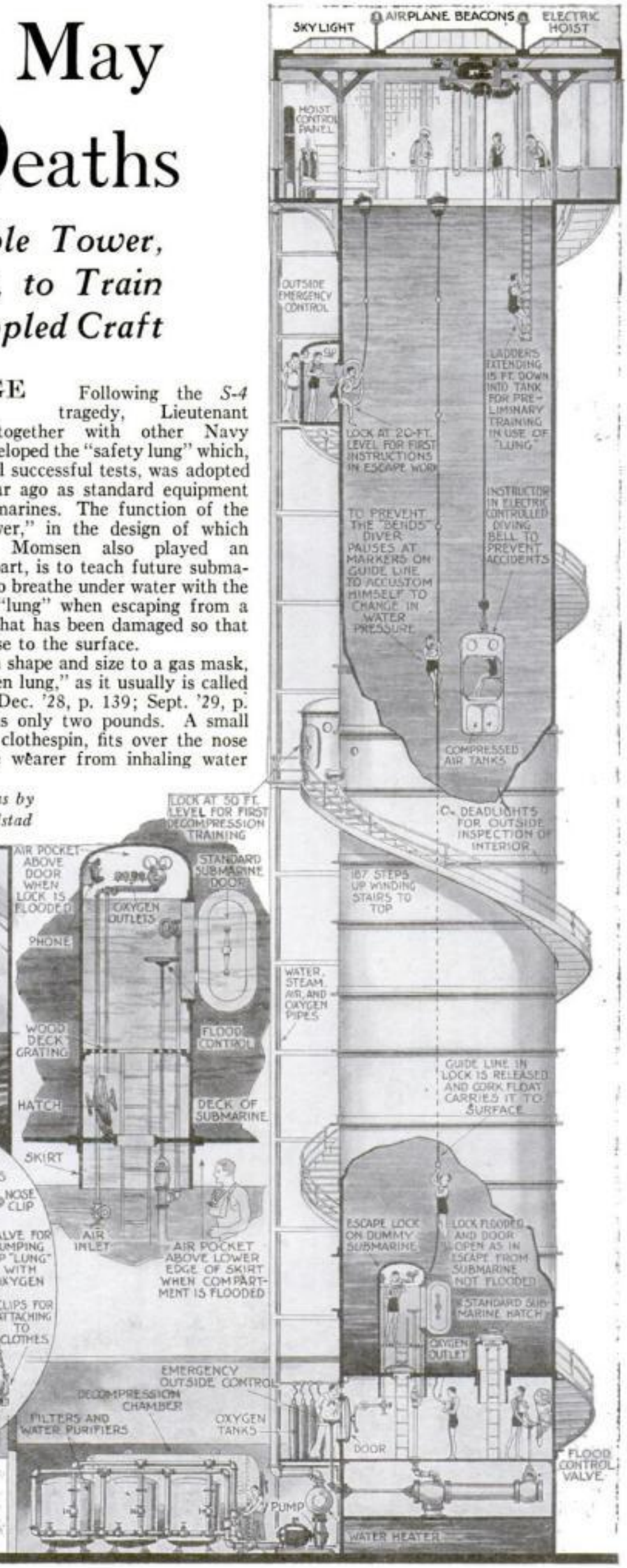
The unique training course starts this month. It will be in charge of Lieutenant C. B. Momsen, U. S N., and other officers stationed on the *S-4*, which was sunk with forty men off Provincetown, Mass., three years ago. Since being salvaged the *S-4* has served as a floating laboratory for experiments with submarine rescue devices.

Following the *S-4* tragedy, Lieutenant Momsen, together with other Navy experts, developed the "safety lung" which, after several successful tests, was adopted about a year ago as standard equipment for all submarines. The function of the "rescue tower," in the design of which Lieutenant Momsen also played an important part, is to teach future submarine crews to breathe under water with the aid of the "lung" when escaping from a submarine that has been damaged so that it cannot rise to the surface.

Similar in shape and size to a gas mask, the "Momsen lung," as it usually is called (P. S. M., Dec. '28, p. 139; Sept. '29, p. 144), weighs only two pounds. A small clip, like a clothespin, fits over the nose to keep the wearer from inhaling water

Illustrations by B. G. Seielstad





Above, the partially flooded lock at bottom of 100-foot tower. Wearing safety "lungs," the men can now escape and begin climbing to surface. In oval, the oxygen-containing "lung" and the mouthpiece. At right, the tower, filled with salt water, through which the members of submarine crew are taught to rise. Cut-outs show a man beginning the ascent and later resting to accustom his body to decreasing water pressure. "Bends" occur if he rises too fast.

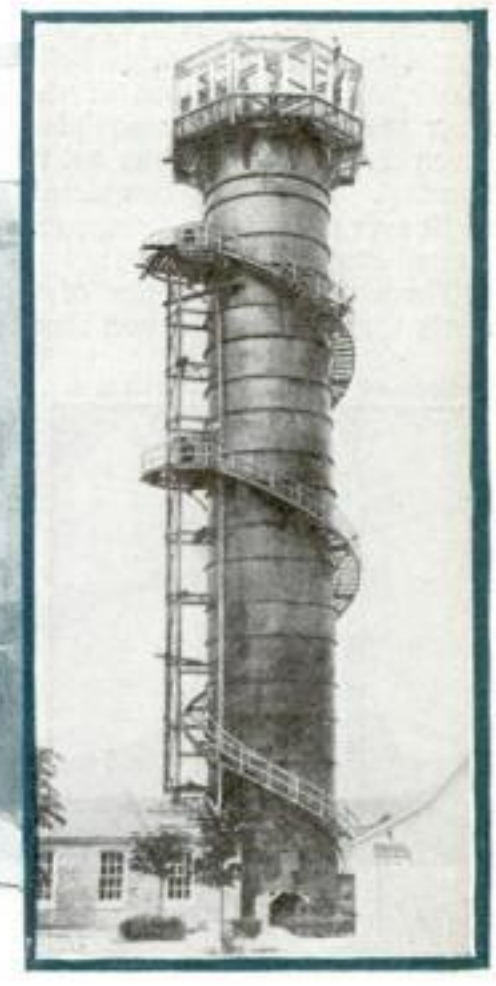
and compel him to breathe through a rubber mouthpiece connected by means of two tubes to a rubber composition bag containing oxygen and attached to the clothes with clips.

The oxygen is inhaled through one of the tubes, while the other, through check valves, leads the exhaled air back into a small compartment filled with soda lime or some other purifying chemical. From this chamber the air goes back into the rubber bag to be inhaled once more. A valve at the bottom of the bag, designed primarily to let excess air escape, changes the apparatus into a life preserver when closed upon reaching the water's surface.

THE other day I made a trip to New London to see the remarkable new structure built at a cost of about $120,000 to teach undersea sailors the use of this small and comparatively simple device which may mean the difference between life and death to them. Constructed of steel and covered with aluminum paint, the 135-foot circular tower gleams in the sun. Huge skylights, and deadlights or small circular windows in the sides, insure high visibility in its water-filled interior. At night, aviation beacons on its top and floodlights on each side transform the tower into a lighthouse for the guidance of passing airplanes.

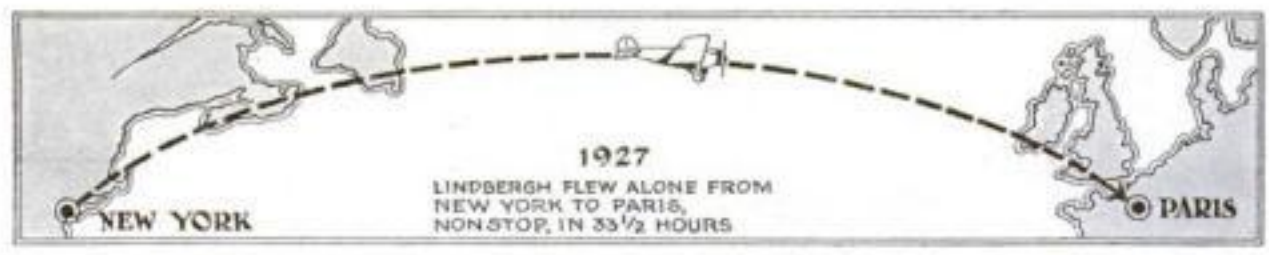
Chief Gunner Loughman, one of the Navy's crack divers, who will be an instructor in the course, and E. P. Warren, civilian engineer in charge of construction, were my guides. Loughman distinguished himself in 1915 by descending to the then record depth of 306 feet during the salvaging of the U. S. submarine *F-4* off Honolulu, Hawaii. Since then he has done splendid work in the raising of the *S-4* and in virtually all of the subsequent submarine rescue tests.

Experiments made in the last two years in the Potomac River off Morgantown, Md., at the Washington Navy Yard, and at Key West, Fla., have shown that men can get out of submarines sunk to a depth of about 350 *(Continued on page 146)*



The tower at the right is being used to train men to make the life-saving escapes pictured above by the artist. It is expected that this training and the safety lung now used will prevent the occurrence of fatalities when subs are disabled. Since the war such accidents have killed more than four hundred and eighty Navy men.

First to blaze the air trail between New York and Paris, Col. Charles A. Lindbergh with Foreign Minister Briand after his flight.



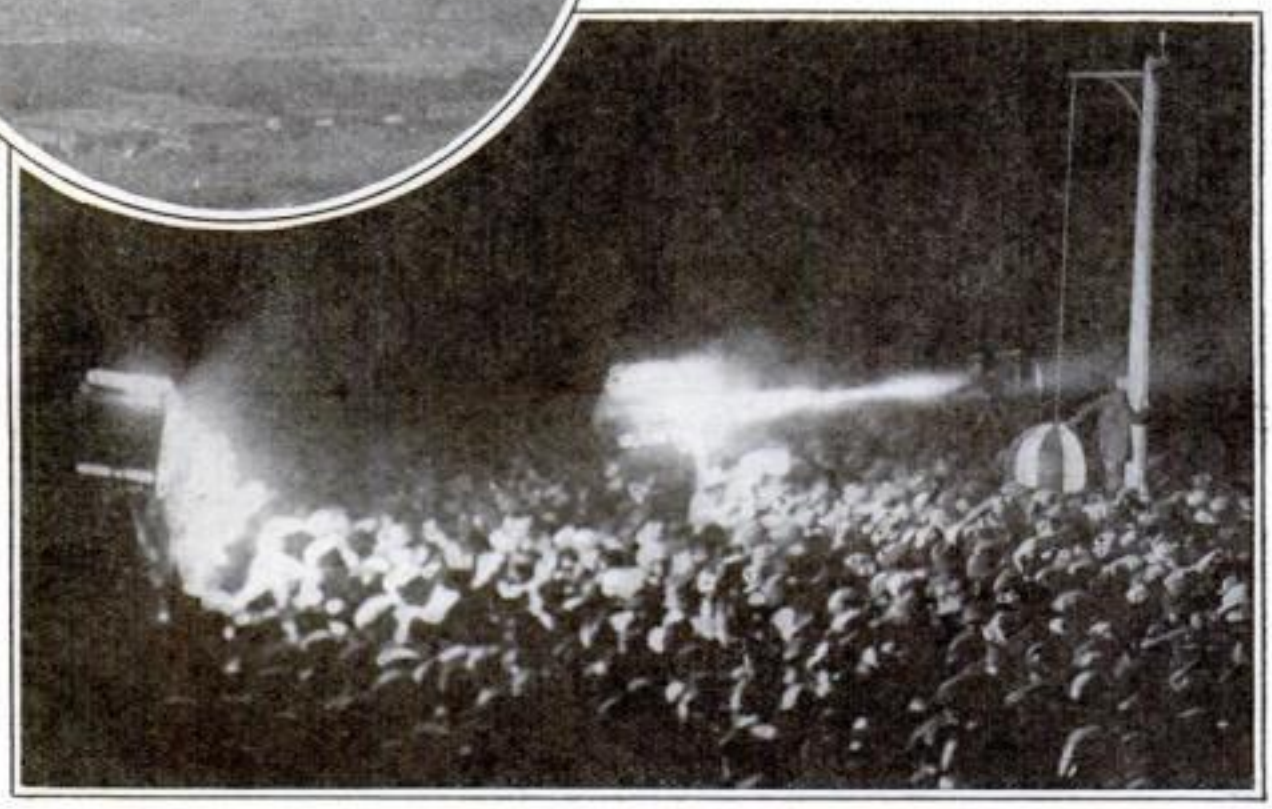
Air Progress from Lindbergh to Coste

TWO SMILING Frenchmen shook hands a few weeks ago, under difficulties, with Col. Charles A. Lindbergh. They were crowded to the back wall of a Valley Stream, N. Y., hangar by a happy, cheering mass of humanity that the word "crowd" fails adequately to describe. Even sturdy cameramen could not elbow through to record with their booming flashlights a historic moment in aviation—the conquerors of the westward Atlantic passage receiving the congratulations of the man who blazed the eastward air trail from New York to Paris.

A few minutes before, Capt. Dieudonne Coste, pilot, and Maurice Bellonte, navigator, had dropped out of the skies in their scarlet Breguet sesquiplane, thirty-seven and a quarter hours out from Paris, nonstop. They had completed the first flight ever made from Europe direct to the United States.

There followed a series of vivid incidents that no one who was there can forget—a souvenir hunter who attempted to snatch a piece of fabric from the plane's wing knocked down by another spectator; the flyers and Lindbergh on a hangar roof, at last, to escape the cheering crush; decoys who donned aviation helmets and left by the front way while Coste and Bellonte were spirited into a car in the rear.

That they succeeded after the tragic failure of others speaks no less for the strides of aviation than for their own dauntless courage. When Lindbergh flew to Paris three years ago, there was not a plane in existence that could have made the westward crossing. Prevailing east-



While the *Spirit of St. Louis*, in circle, was winging its way toward Paris, in 1927, these vast crowds awaited it in the glare of searchlights, near the Paris landing field.

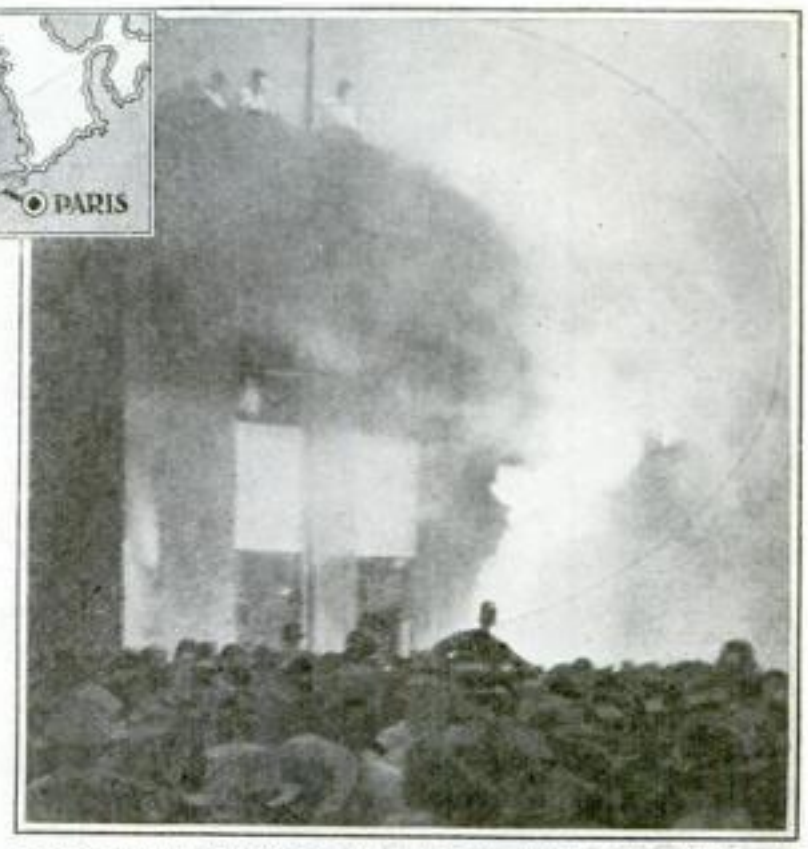
When Lindbergh flew 1,572
When Coste flew 9,472

Before Lindbergh Flight 5,782 a year
Before Coste Flight 165,263 a year

Before Lindbergh Flight 810,855
Before Coste 7,100,000

Time of Lindbergh Flight 1,064
Time of Coste Flight 8,027

Giant Stride in Aviation in Three Years Gave Westward Flight over the Atlantic Its Success in Spite of the Head Winds That Cut Plane's Speed and Ate Up Fuel



Photographers' flashlights silhouette the crowd that overwhelmed Coste and Bellonte with welcome as they end their long flight.

"Here they come!" The scarlet Breguet glides to a landing after its transatlantic crossing in about 37 hours.

The end of the first Paris-New York flight. Capt. Dieudonne Coste (right) and Maurice Bellonte step from plane, to receive a wild American welcome.

ward winds are almost insuperable obstacles to the westerly flyer. Bad weather off the Newfoundland banks trouble the aviator who has managed to get even that far. It remained for Coste and Bellonte to demonstrate that there was a plane that could do it.

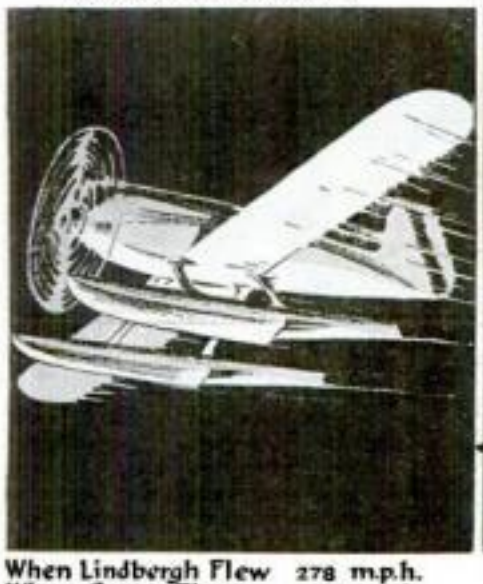
Comparisons with Lindbergh's flight are inevitable. They are highly creditable to the Frenchmen. The westward flight is infinitely more difficult than the eastward because of headwinds that drag down a plane's speed and rob it of fuel. Yet Coste and Bellonte successfully covered 4,100 miles westward to Lindbergh's 3,610 miles to the east, with an almost identical flying average of 109 miles an hour.

The Frenchmen, with their 14,000-pound load, took off easily after a 2,500-foot run. Lindbergh had a hard time getting aloft with a load of 5,200 pounds after a run of 3,800 feet. It is also to their credit that the men in the 650-horsepower crimson Breguet sesquiplane were able to advise the world constantly of their progress by radio. Lindbergh carried none in his 200-horsepower Ryan monoplane, presumably because every ounce of weight was precious, and had he met with accident the world might never have known his fate.

Americans need not fear a slight to Lindbergh in acknowledging the Frenchmen's really superior achievement. It simply bears witness to the tremendous progress that aviation has made since Lindbergh, alone, blazed the trail three years ago.

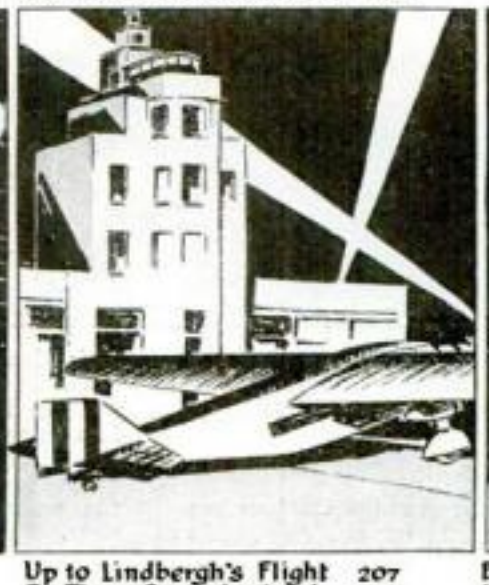
The figures at the bottom of these pages show the astounding development of flying in the mere three years that elapsed between Lindbergh's and Coste's flights.

WORLD'S SPEED RECORD



When Lindbergh Flew 278 m.p.h.
When Coste Flew 357 m.p.h.

MUNICIPAL AIRPORTS IN U.S.

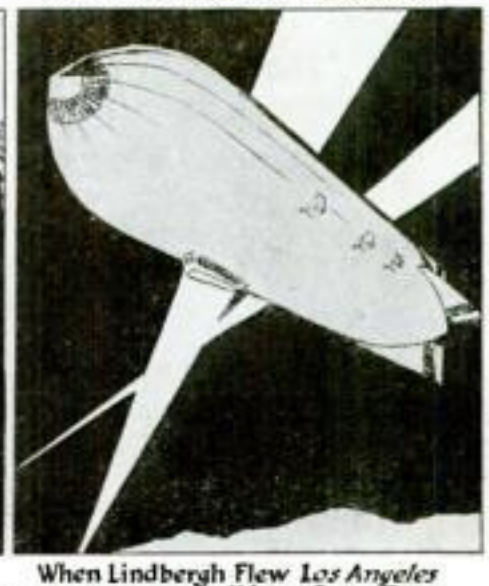


Up to Lindbergh's Flight 207
By Time Coste Arrived 453

MILES FLOWN YEARLY IN U.S.

Before Lindbergh Flight 12,000,000
In Year before Coste Flight 150,000,000

WORLD'S BIGGEST AIRSHIPS

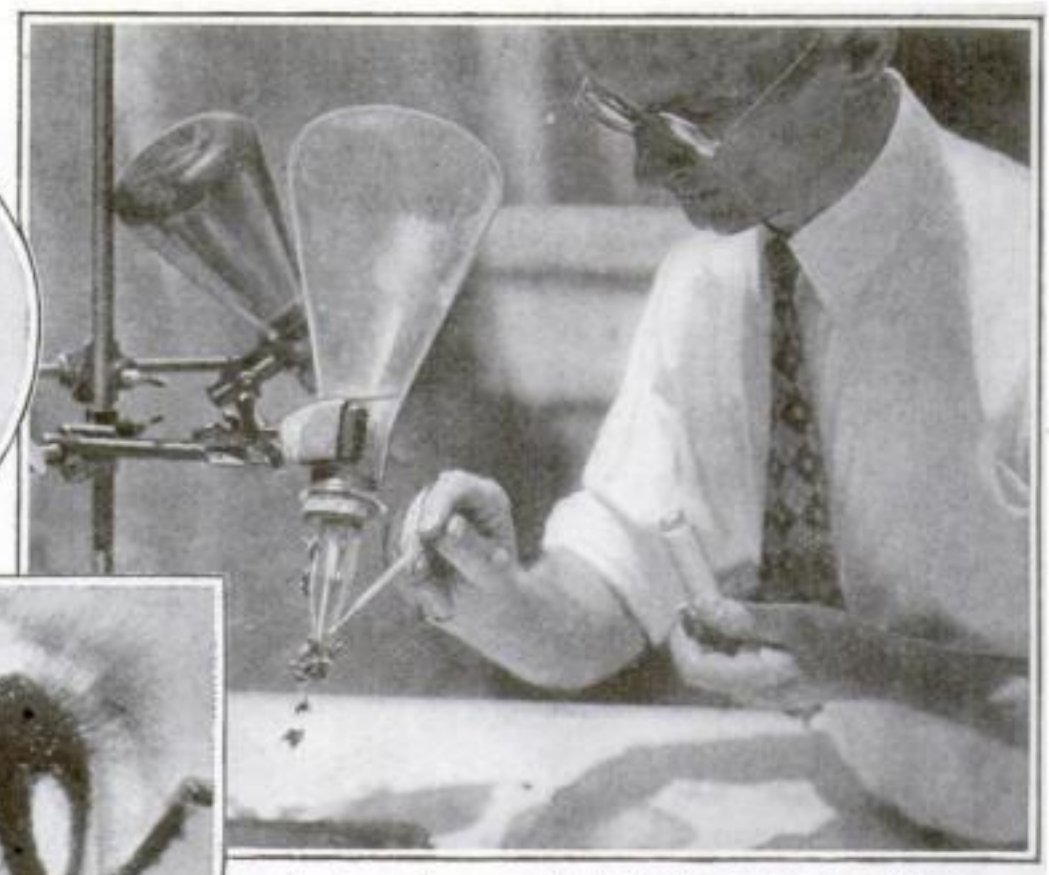


When Lindbergh Flew *Los Angeles* 2,470,000 CU.FT. When Coste Flew R-100 and R-101, 5,000,000 CU.FT.

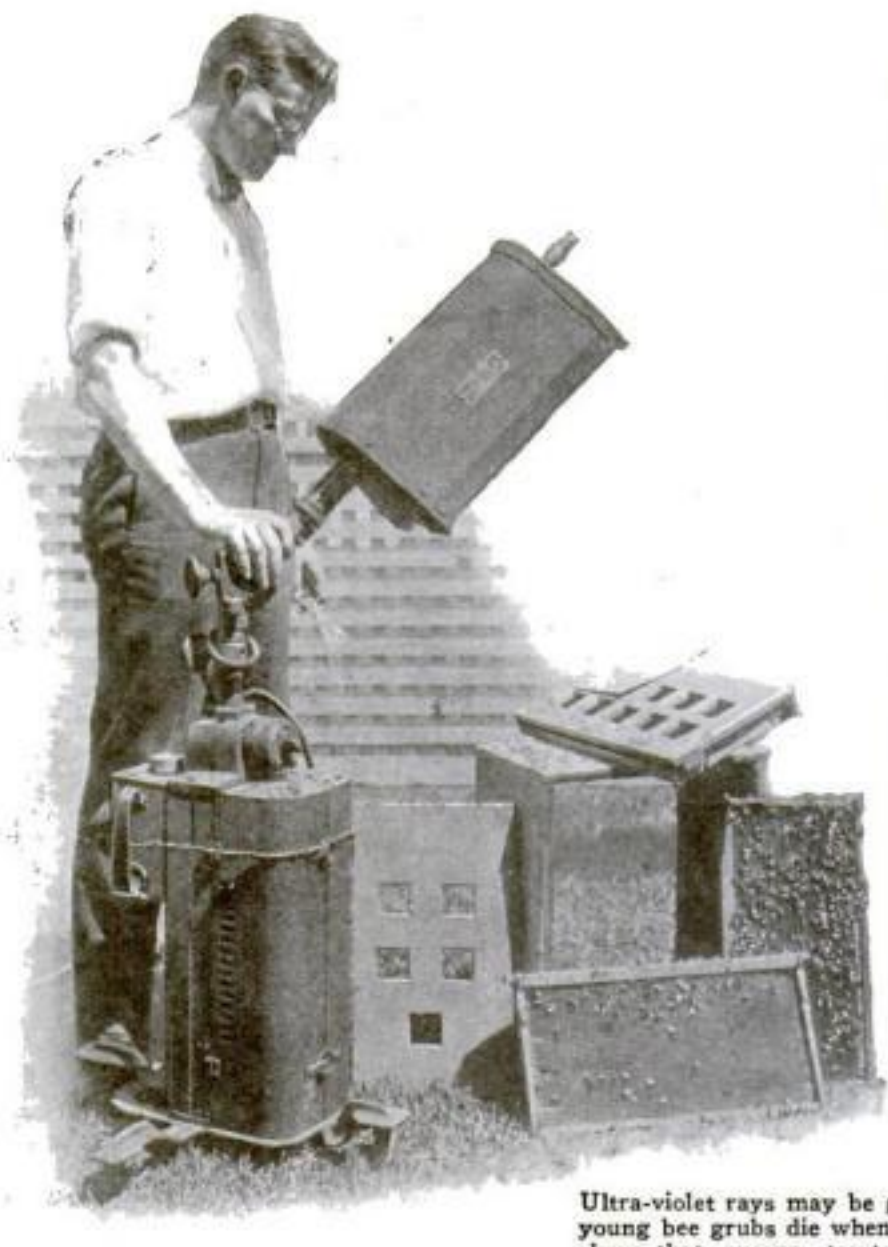
NEW RACE OF BIG HONEYBEES NOW BEING BRED

These scenes from the Department of Agriculture's bee laboratory show how Government experts are trying to develop stronger bees capable of covering a wider range—Various strains are crossed while six million are under observation.

Breeding may make the honeybee, seen in the oval, the founder of a new race, and may give to his face, below, a longer proboscis.

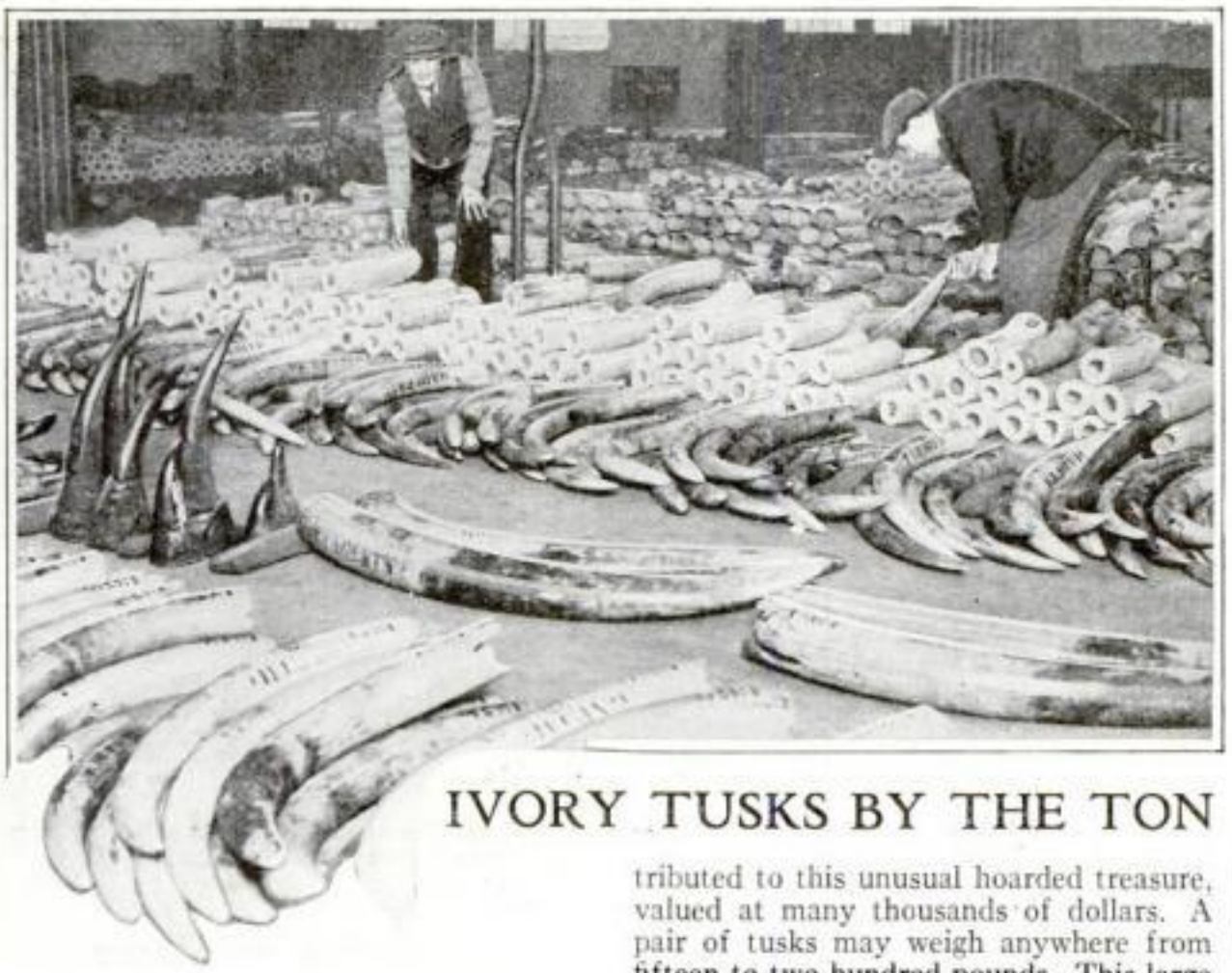


To keep tabs on a particular bee's movements, a Government expert lures it with an "artificial flower" and marks it with a spot of color. Aided by this identification, experimenters found that the average bee makes between ten and twenty trips for honey during the day and spends a little less than an hour away from the hive on each trip. Experts now hope to breed a bee with stronger wings and a bigger honey stomach so that it will be able to fly farther and bring back a heavier load of honey. The picture shows a drop of color being applied, with a medicine dropper, to the bee's body. The "artificial flower" by which the bee is attracted is a flask of sugary syrup and will readily collect a number of bees when placed near a hive. But this syrup is not the only thing that attracts bees. Tests proved that the color of the flowers plays an important role. Studies recently made showed bees can see light waves that are invisible to man.



Ultra-violet rays may be good for growing children but young bee grubs die when exposed to them. Also, tests show that queens, treated with the rays, receive no benefit, but on the contrary seem more likely to be deposed as hive rulers. These discoveries were made when experts tried sun lamps as aids in creating an improved race in the laboratory near Washington, D. C.

This hive houses a colony of a hundred thousand bees. It is mounted on a delicate automatic recording balance that charts the hive's gain or loss in weight from hour to hour, thus giving a check on the movements of the bees and their production of honey. When a storm approaches, the workers flock to the hive and its weight rises. Honey weight is measured from day to day by taking readings at dusk, as the woman shown in the picture is doing, when all the bees are in the hive. The hive produced twenty pounds of honey during a twenty-four-hour period. But the Government hopes its new bees will do better yet.



IVORY TUSKS BY THE TON

BETWEEN thirty and forty tons of elephant tusks from the wilds of Africa and Asia were banked together recently in a sale room at Mincing Lane, London, England—one of the chief ivory markets of the world. Seven hundred elephants contributed to this unusual hoarded treasure, valued at many thousands of dollars. A pair of tusks may weigh anywhere from fifteen to two hundred pounds. This large batch of the precious material was dispersed to various manufacturers at a special sale, thence to be made into billiard balls, piano keys, combs, toilet articles, umbrella handles, chess men, and numerous other objects.

PLUNGER IN TOOTHBRUSH MAKES BRISTLES WHIRL

BRUSHING the teeth up and down, as dentists advise, is easy for those who use a new rotary toothbrush. When the handle is gripped and a sliding rod pushed in and out, the brush spins. After use, a few rapid movements of the plunger serve to rid the whirling brush of excess moisture and allow it to dry, preserving the bristles. The secret of the brush's spin is a spiral screw on the plunger, similar to the drive commonly used in small hand drills.

Spiral screw in toothbrush handle whirls bristles against teeth as plunger is pushed in and out.

CARS HURLED INTO AIR FURNISH NEW THRILL

"LEAP-FROG" cars provide the latest thrill for amusement seekers on the Steel Pier at Atlantic City, N. J.

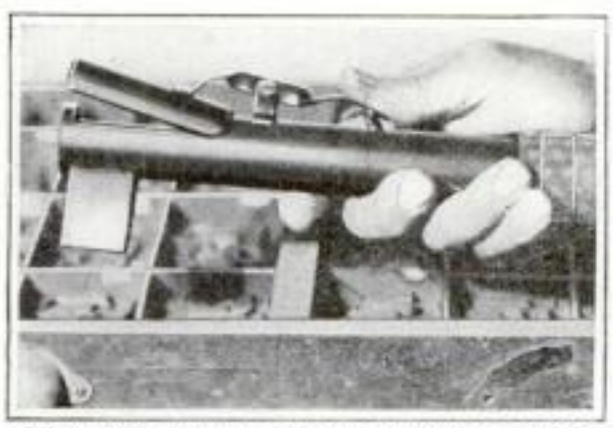
Streaking down a steep descent at dizzy speed, dare-devils in small steel cars leap from fifteen to twenty feet into the air, over one another, when reaching the up-curve at the bottom of the incline. The track has been carefully designed and laid out so that the cars may not only attain the greatest possible speed and make startlingly high jumps, but, after their aerial acrobatics, will "land on their feet," insuring the comparative safety of the drivers.

The stunts are similar to those of the old circus days when a car, rushing down an incline, leaped a gap. The little steel cars make higher jumps, however, than were possible with the circus machines.

COAT HANGER PEDALS USED TO PLAY PIANO

COAT hanger pedals attached by rods to the bass keys of a piano enable Charles H. Jennings, of Pittsburgh, to play parts in the lower range of the piano with his feet, while with his hands he is playing in the upper scales. With this arrangement, he can play compositions that ordinarily would be impossible. The coat hangers are a temporary installation which Jennings plans to replace with pipe organ pedals.

Using coat hangers as pedals to play the bass, C. H. Jennings gets double duty from piano.



With this vacuum cleaner mouthpiece, small places, like type cases, can be easily dusted.

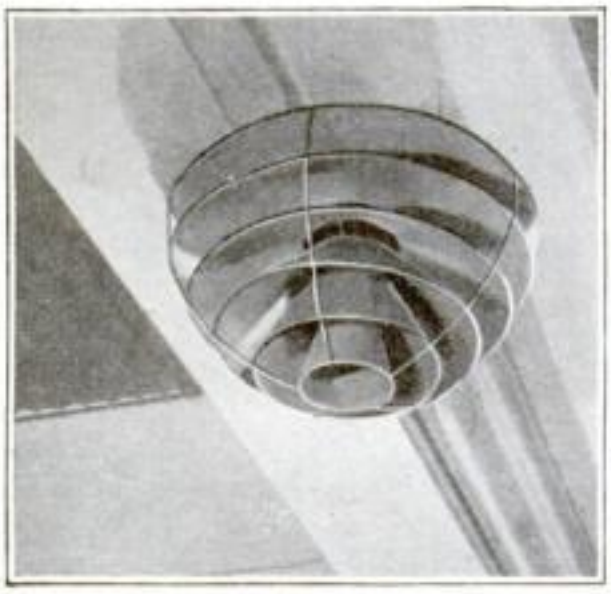
THIS VACUUM MOUTH DUSTS SMALL PLACES

A NEW "mouth" for a vacuum cleaner hose sucks dust from drawers with compartments containing small articles. The drawers need not be emptied. Designed for use in printers' shops, where type is kept in cases divided into sections, it also has proved useful in surgical supply houses and typewriter repair shops, where small parts for sales and repairs are stored in cases and drawers. The attachment can be made in various sizes.

CLIMBING VINES HELD IN PLACE BY METAL HOOKS

SMALL metal hooks that can be inserted either in wood or masonry aid the house owner in achieving the picturesque effect of a wall or chimney covered completely with climbing roses or other vines. If the surface is wooden, the nail is simply driven into the wood and the soft metal hook bent toward the wall and around the vine tendril, which thus is prevented from having its own way, kept in place and safeguarded from the effects of wind. In the case of a masonry surface, the hooks are inserted in shells which fit into holes in the wall made by means of a special drill and drill holder.

To make the holes in the masonry, the drill is put in the holder, the end of which is hammered lightly. The drill is rotated by hand at each stroke.



NO DIRECT DRAFT WITH NEW TYPE VENTILATOR

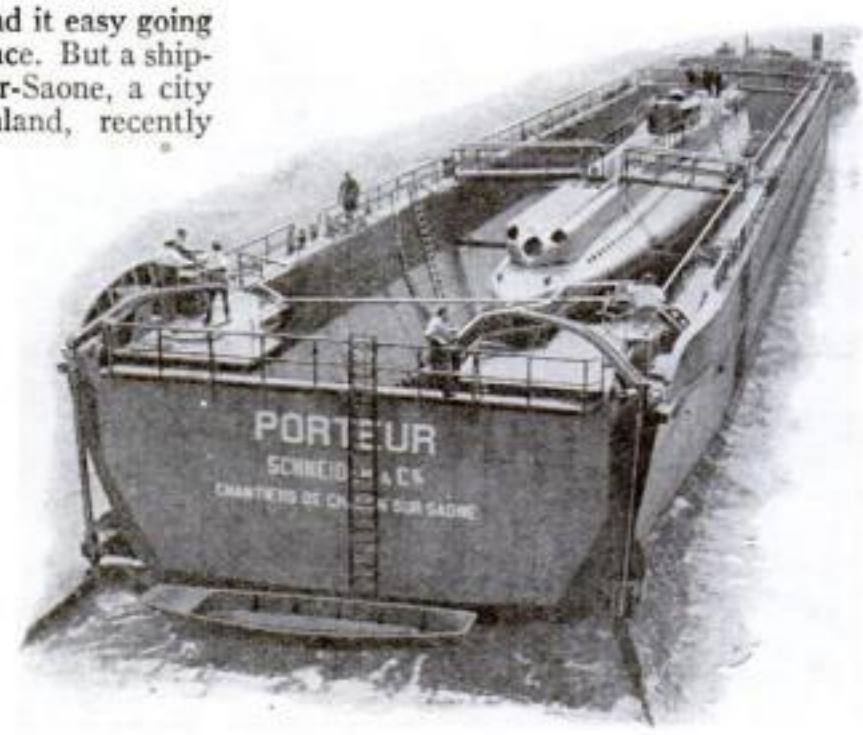
A NEW type of ventilator, whose inlets resemble large artificial flowers, gives protection against draft, according to the statement of the manufacturer in Germany. Placed on the ceiling and walls of the room, the outlets are fashioned in a series of concave disks that break up the current of air. The sheet-metal plates thus distribute the incoming air equally throughout the room, avoiding a direct blast or draft.

Other features of this novel ventilator are its "artificial weather making" properties. The outside air is passed through a humidifier, which gives it the proper moisture. A heating arrangement automatically warms the air to correct room temperature.

ODD VESSEL BUILT TO CARRY "SUB"

SUBMARINES wouldn't find it easy going in the shallow rivers of France. But a shipbuilding firm at Chalon-sur-Saone, a city more than 200 miles inland, recently delivered the submersible *Argonaut* successfully to its base in the Mediterranean Sea.

The photograph shows how the feat was accomplished. A specially built "submarine carrier" served as a floating dry dock for the undersea craft, which was carefully braced against any possibility of shifting. Then the odd carrier journeyed down the Rhone River in the tow of a tugboat. A pair of rudders at the stern of the "sub" carrier served the double purpose of steering the craft and slowing it.



Loaded on a huge flatboatlike carrier, a French submarine was carried across France 200 miles to the sea.

SMOKE VEIL GUARDS CITRUS TREES

EIGHT million dollars worth of citrus fruits—lemons, oranges, limes—are put to bed under a protective blanket of oil smoke in the vast orchards of the San Joaquin Valley in California whenever frost threatens. This is the method that the fruit growers of this western orchard kingdom employ to guard their precious ripening tree crops from death by cold during the fall and winter months. From October to December, especially, care must be taken to swathe the trees in a warm veil of heavy smoke, thus combating the frost by giving it no chance to attack the tender fruits maturing on the boughs.

The apparatus for spreading the guardian smoke throughout the orchards is a unique combination of the old and the new in science. When the temperature falls to the freezing point (thirty-two degrees Fahrenheit) the growers are informed by an automatic alarm device placed in the orchard. A metallic thermometer that indicates temperature changes by expansion or contraction of a strip of metal makes an electrical connection which gives a warning to the fruit owners living in the vicinity. The growers then hasten to the orchards and light huge lamps or smudge pots stationed at regular intervals along the aisles between the trees. This smoke screen acts as a blanket around the trees, so that the air that comes in contact with them cannot chill to the dangerous freezing point. In this way many fine orchards have been saved.

These devices, tall as men and resembling the familiar domestic lamps of fifty years ago, give off a pungent cloud of oil smoke which settles on the leaves and fruit. This cloud acts as a protection to keep the heat in and so maintain a practically even temperature. The oily smoke has no injurious effect on the trees or their fruit.

Above, the device that automatically warns fruit growers of dangerous drop in temperature. At right, one of the oil burning smudge pots from which the protecting curtain of smoke is thrown out.

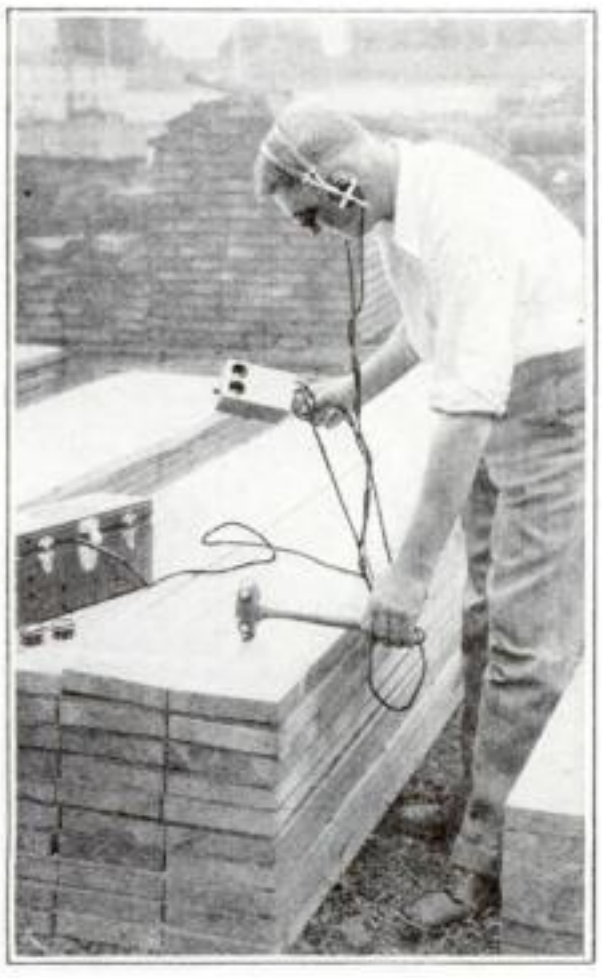
MOVIE MADE AS SURGEON OPERATES IN BERLIN HOSPITAL

The ball-shaped object, center, is a motion picture camera filming an operation in a Berlin hospital.

Above, the side of the camera case has been removed while it is being focused on operating table.

MOVIES are taken of operations in a German hospital in Berlin by means of a queer motion picture camera suspended over the operating table in a ball-shaped metal case.

The films taken in this modern addition to hospital equipment are used by doctors in studying the reaction and condition of patients undergoing an operation. They are also run off to teach surgical technique to students. All the apparatus necessary to a complete film studio has been installed.



BLINKING LIGHT TELLS DAMPNESS OF LUMBER

How damp is a piece of lumber? Blinking lamps tell the facts almost instantly, in an ingenious electric device recently developed by the U. S. Forest Products Laboratory, at Madison, Wis.

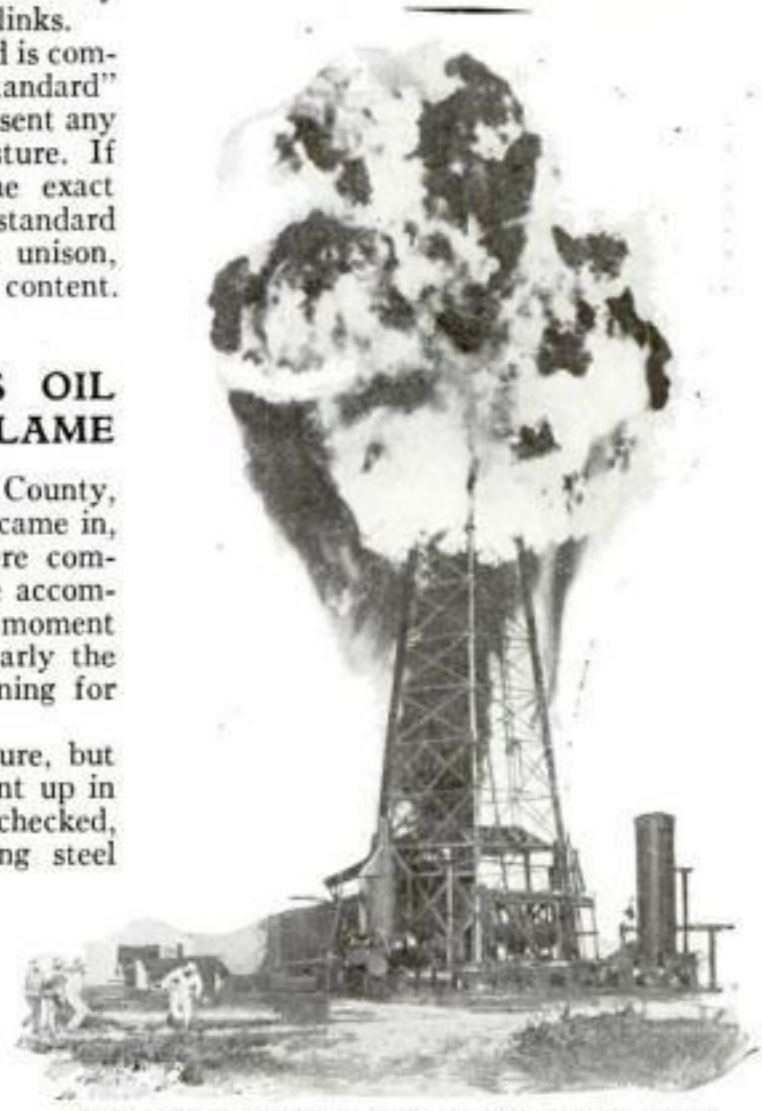
The new "blinker" machine's artificial "feeler" is a set of sharp prongs, mounted on a hammer to be driven into a piece of wood under test. Electricity passes from one pair of prongs to another, its volume depending upon the amount of moisture in the wood. This electrical flow is shown by the rate at which a neon light blinks.

The number of blinks per second is compared with that of another "standard" blinker, which may be set to represent any predetermined percentage of moisture. If the user desires to measure the exact moisture content, he adjusts the standard blinker until both lamps flash in unison, and then reads dial for moisture content.

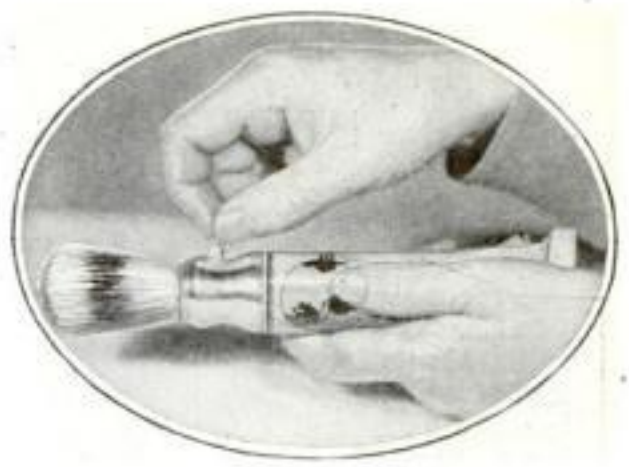
CAMERA ON JOB AS OIL WELL ROARS INTO FLAME

WHEN an oil well in Ector County, Texas, burst into flame just as it came in, the men in the drilling crew were compelled to flee for their lives. The accompanying photograph taken at the moment the explosion occurred shows clearly the powerful blast and the men running for cover.

The photographer got his picture, but nearly lost it when his tripod went up in flames. Before the fire could be checked, the steel derrick and surrounding steel construction buildings were melted in the heat. It is believed that a piece of flint-like rock, loosened by the nitroglycerine blast with which the well was being "brought in" and driven upward by the gas pressure, struck a spark which ignited the gas.



This unusual photograph was caught by the camera at the instant this big oil well exploded into flames.



NEW SHAVING BRUSH CLIPS TO CREAM TUBE

THERE is less hunting for the missing utensils of a shaving kit, now that a brush has been invented that can be attached directly to a tube of your favorite shaving cream. The tube serves as a handle for the brush. Squeezing the tube slightly shoots the proper amount of cream right into the center of the bristles, where it will not fall off.

A plunger on the side of the attachment must be pressed before the cream can be released. It closes automatically, sealing tube and keeping cream from drying.

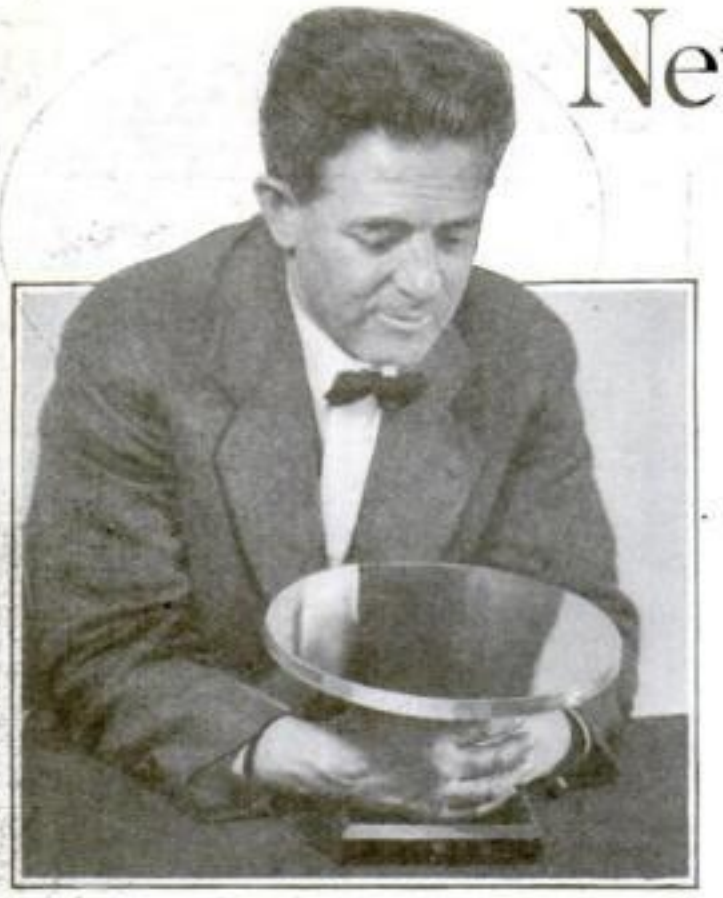
OUTBOARD MOTORBOAT HITS 50-MILE SPEED

TRAVELING at almost fifty miles an hour, Ray Pregenzer, of Antioch, Ill., recently set a new world's speed record for outboard motorboats. His official speed was 49.723 miles an hour. The record was made during recent speed trials on Fox Lake, Ill.

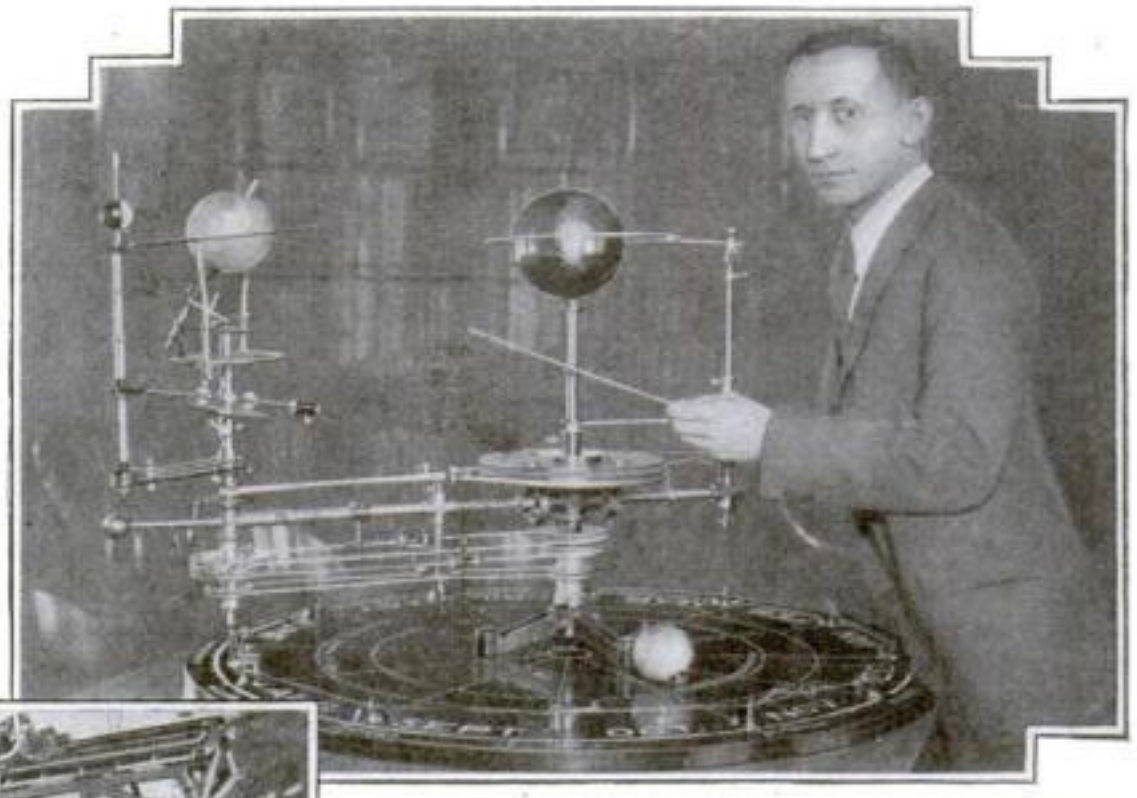
Manufacturers of outboard motors are now wondering just how fast boats can be driven by these engines. At present fifty miles an hour looks like the maximum.

New Ways to Study Stars

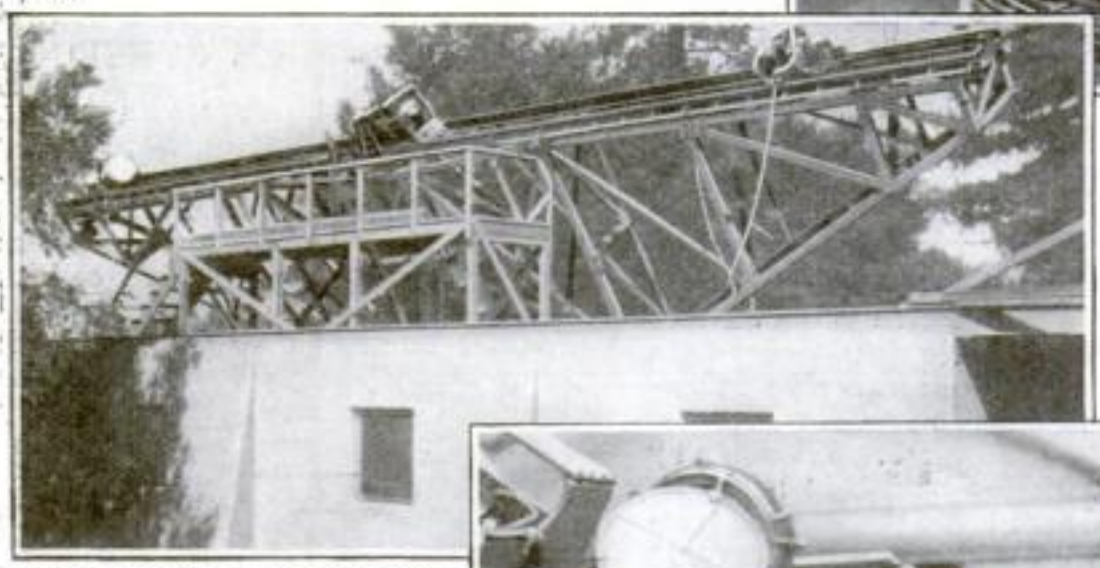
Latest Improvements in Instruments Make Astronomy Easy for the Novice—Pygmy Telescope Rivals Biggest Ones



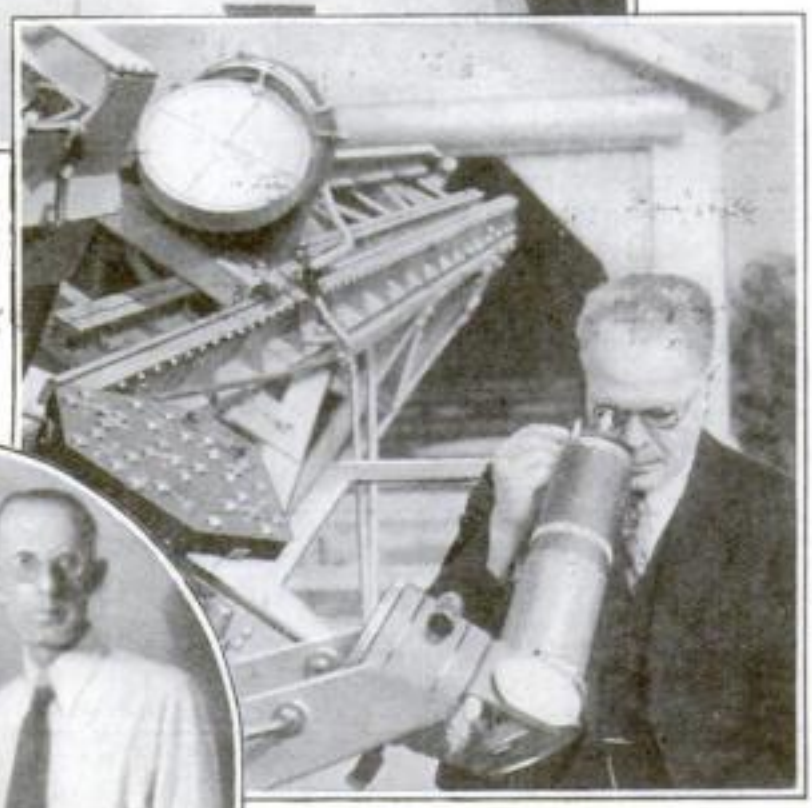
STAINLESS STEEL SHOWS STARS. No longer will builders of telescopes be obliged to use costly and fragile glass or quartz mirrors, if the process now being developed by G. H. Lutz, Philadelphia metallurgist, is successful. As Lutz's mirrors are of steel alloy, and unbreakable, telescope costs may be cut.



SOLAR MOVEMENTS AT A GLANCE. This intricate machine, built with the utmost mathematical precision, is adjusted to show a class of astronomical students the gradual change in relative positions of the sun, moon, and earth. Though the apparatus itself is complicated, its operation is simple—turning a crank swings the sun and planets through their phases and changes are then easily pointed out.

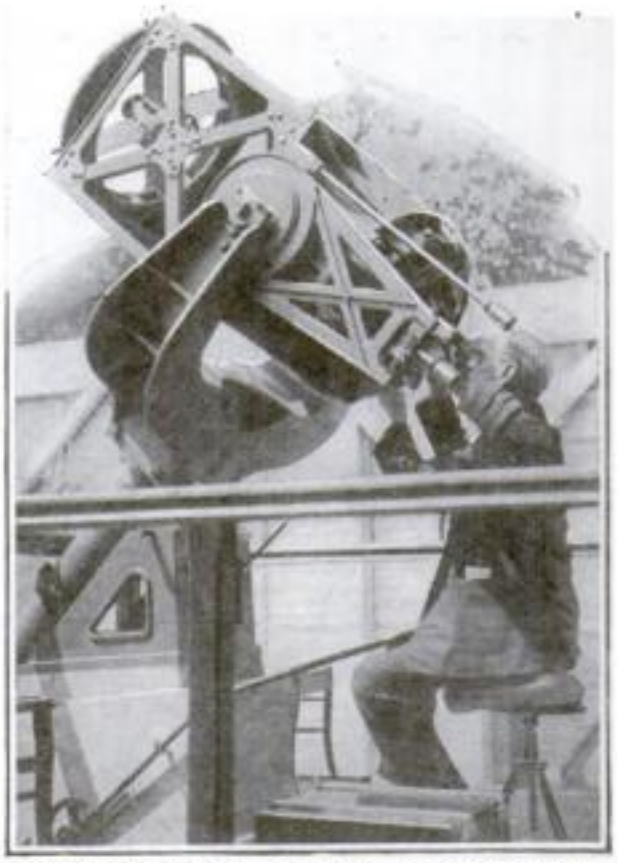


THE HUNT FOR BIGGER SUNS. Mirrors mounted on a fifty-four-foot steel bridge, and connected with the 100-inch telescope at Mt. Wilson Observatory, Calif., are to be used in the effort to measure size of remote stars.



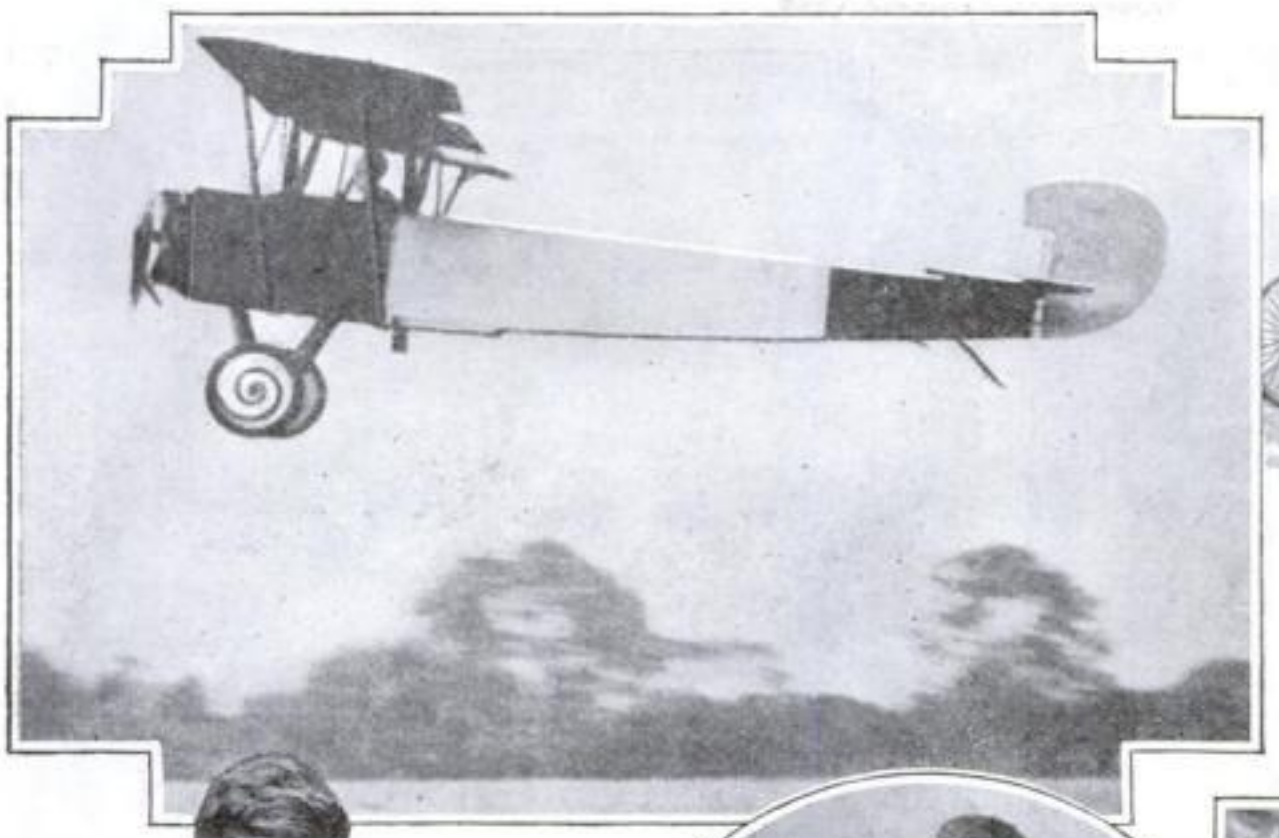
TWO EDGES OF A STAR. Peering through an eyepiece at Mt. Wilson, the astronomer sees the image reflected by two mirrors and with the data thus obtained determines size of solar giants.

SOLAR SYSTEM IN GLASS GLOBE. The sun, earth, and planets are shown within a sixteen-inch glass globe designed and developed by Otto Jerome Russert of Schenectady, N. Y., for use in teaching astronomy. The constellations, with their names, also appear as well as comparative sizes of planets.



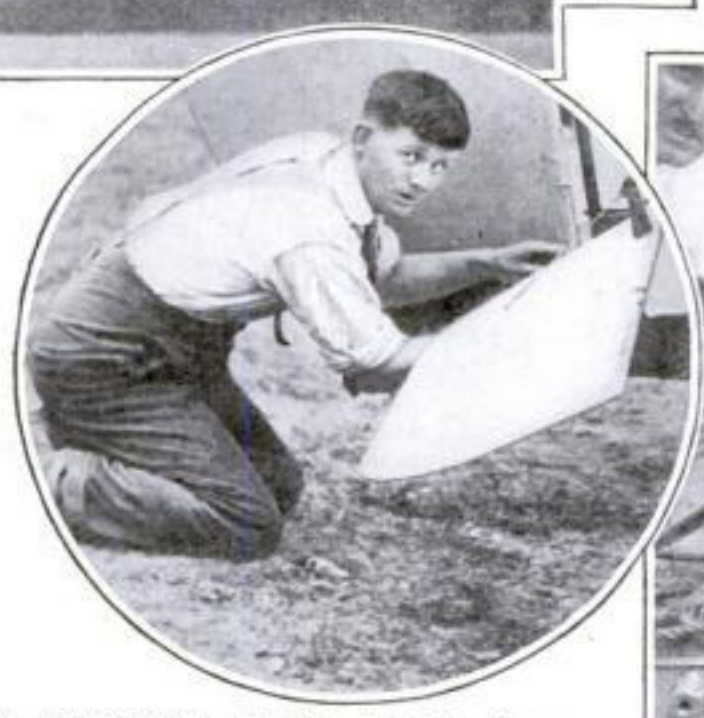
LITTLE GIANT AMONG TELESCOPES. Only fifty-four inches long, this telescope, developed by G. W. Ritchey, American astronomer, is said to be superior in some ways to the mighty instruments in use at the big observatories. It is now being used in France, but Ritchey plans to build one eighteen feet long in America. This new type instrument, he says, will be the most powerful ever constructed.

They Built Their Own



HIS OWN RAILROAD CAR. Walking four miles to work every day seemed a waste of time to John Lamey, Hoquiam, Wash., so he bought four pressed paper wheels, and with light metal tubing attached them to a bicycle frame and now he rides the track to his work.

FIDDLE MADE BY HAND. Putting together 2,500 matches with waterproof glue, Arthur Groverman, Washington, D. C., made himself a violin, the finished instrument being shown above.



A JUNK-HEAP PLANE. Material thrown away by the Royal Air Corps was used by Stanley Buckell of Abingdon, England, to build an airplane that not only flies but was so strong and safe that it passed the rigorous British Air Ministry tests. The total cost was about $85. In the circle, Buckell is seen making final adjustments. Top photo shows plane in flight.

HOMEMADE DIVING SUIT. Old inner tubes, patched together for fabric, and a three-gallon water bucket as a helmet, with an old-fashioned beer pump to furnish air, constituted a diving suit made by Kent Kyle of Chicago, Ill. The pieced-together suit has proved so satisfactory that Kyle has been able to remain under the water for six hours in it.

A BACK YARD CIRCUS. When the circus fever hit Walter Matthie, 17, of Long Beach, Calif., he went to work and in three years built one for himself. It is now complete to the last stake puller and flaming banner. There are forty-one wagons, nine cages filled with animals carved by the boy, and fully equipped main top, side show, dining, and living tents.

NEW SHOES NOW SHAPED TO FIT LIKE OLD ONES

WHY are old shoes more comfortable than new ones? To find out, Abraham Sachs, shoe dealer of Salisbury, Md., made a practice of inserting his hand in each pair that a hard-to-fit customer had been wearing. He found that a shoe begins to be comfortable when the sole has taken the shape of the customer's foot, a process that often took considerable time. Having got this information, Sachs invented a device that would immediately shape the leather to the form which it would eventually take in any event.

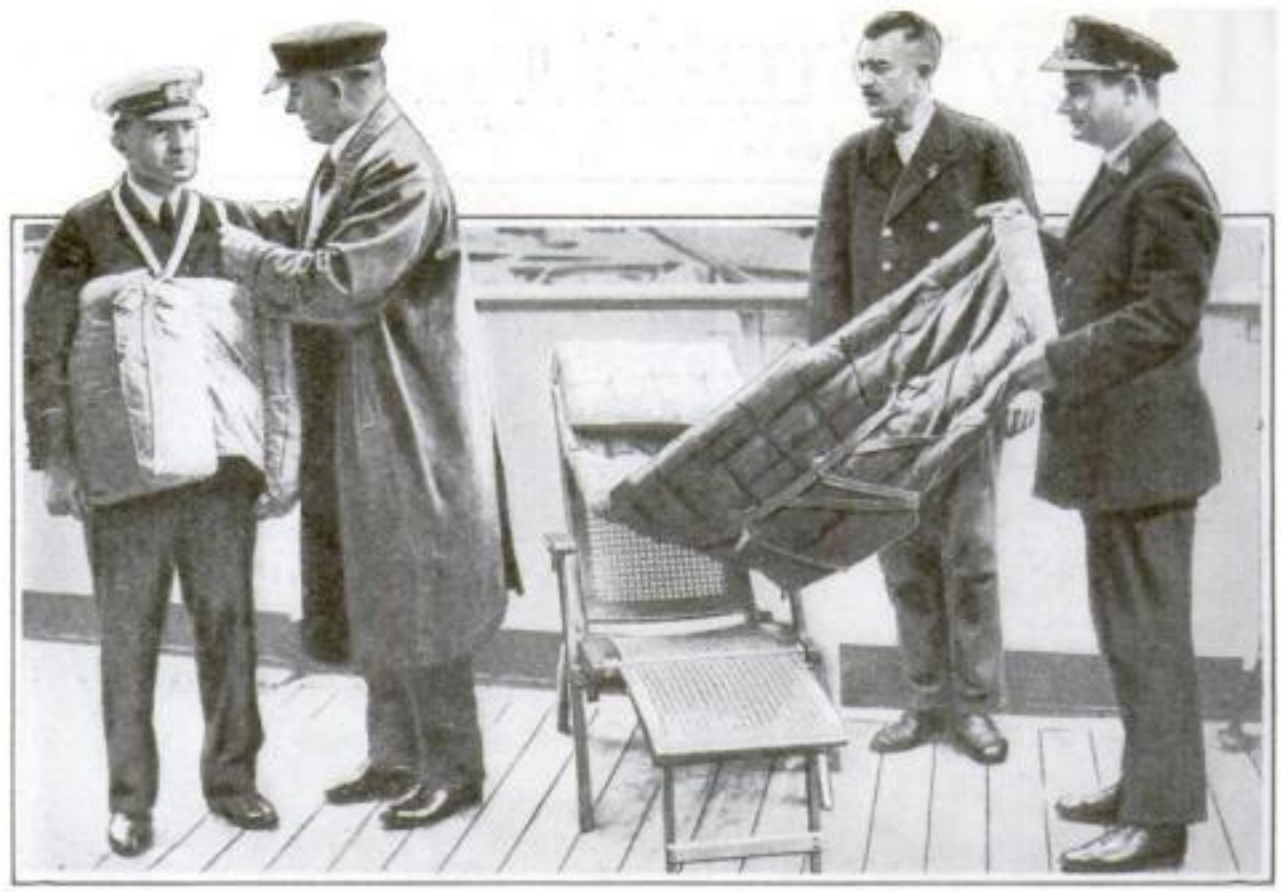
His device is a hand press in which the shoe to be fitted is placed. A metal form is then inserted. Perforations on the form allow special "bumps" of metal, corresponding to the shape of the customer's foot, to be added. Then a few turns of the press handle, and the shoe is said to be as comfortable as if it had been worn for months.

With this hand press and a metal form of the foot to be fitted, shoe dealers are now able to make new footwear feel comfortable at once.

NARCOTIC BULLETS PUT WILD BEASTS TO SLEEP

BIG game hunters for zoological gardens can now capture wild beasts by shooting them with hypodermic needle bullets that put them to sleep.

These "mercy bullets" have the appearance of miniature aerial bombs, fins at the rear keeping them on a straight course. When the projectile strikes the animal it shoots a quantity of narcotic into its blood stream. Within two minutes, the beast falls into a sleep that lasts for an hour or more, the inventor of the new drug bullet explains.



USE LIFE PRESERVER AS CUSHION

TIMID passengers at sea may be reassured by the fact that the cushion of a new style of deck chair is itself a life preserver. British liners recently introduced the novelty. The cushion is said to be capable of supporting three persons in the water. For use, it is removed from the chair and strapped around the body.

MOUNTING HELPS FLAG FLY FREELY

THE American flag is neither beautiful nor glorious when tangled around a pole. At least that is the way it seemed to Robert Peters of New York, a World War veteran. So this former chief gunner's mate on a Naval mine sweeper has invented a device that is expected to keep the flag from winding itself around the staff.

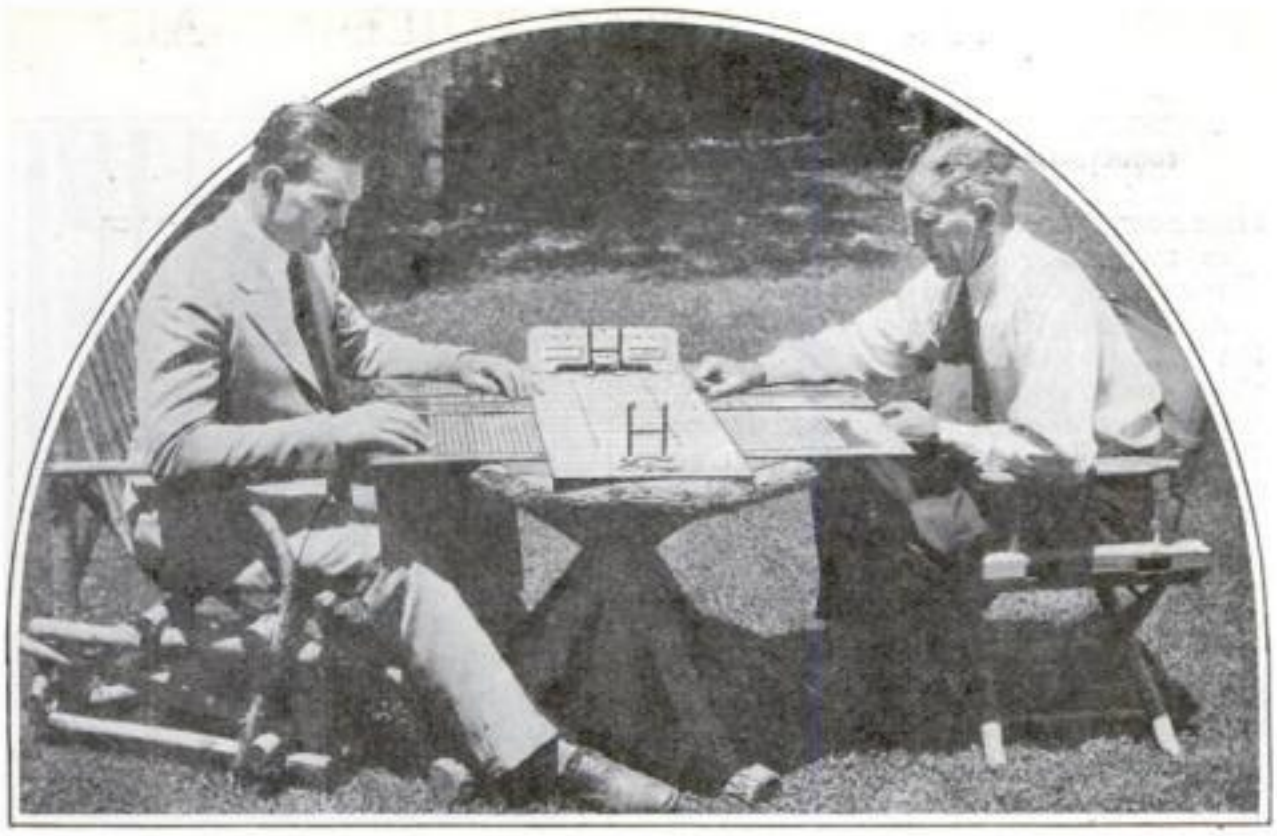
A few turns on the crank handle of his new flagpole mounting and the pole revolves, thus loosening the tangled folds of the flag and allowing it to fly as it should. The device does not interfere in any way with the regular use of the halyards. The inventor is shown at the right demonstrating his device.

English farmers are using these two types of portable hothouses to speed plant growth.

Flags tangled around the pole can be unwound with this device as the crank turns the pole.

ONE-PLANT HOTHOUSES NOW USED IN ENGLAND

"ONE-PLANT hothouses" are being used on English truck farms to speed up the growth of vegetables. One farm uses 2,000 of the forcing jars which are placed over plants to protect them from chill and to speed up their development. These tiny hothouses are either solid glass and bell-shaped or tiny panes set in a pyramid-shaped metal frame. The latter type is growing in favor because the panes can be replaced in case they are broken. Each type has ventilating holes near the top. Both kinds are shown in the picture together with the vine of a vegetable marrow grown under one of the glasses.



PLAY FOOTBALL ON 32-INCH FIELD

A THIRTY-two-inch field forms the gridiron of an indoor football game invented by H. H. Jones, football coach at the University of Southern California. The manner in which the game is played gives all the unexpected twists of a real outdoor contest. It lasts for an hour and is divided into quarters just as is an intercollegiate contest. It is governed by the same rules that regulate the plays in actual gridiron battles.

Two play the game. The player on the offensive, like the quarterback on a real football team, selects his play on the "playfinder" at the side of the field, then spins a needle which indicates where to look on the side panel for the outcome of the play. On this panel a total of 652 possible results are listed. The results of plays are arranged in groups to make the winning and losing as real as possible and to provide unexpected thrills.

Thus as the goal posts are neared the chances of gains become relatively few—as is generally the case in an actual outdoor contest. The field is arranged in zones and in each only the plays that a quarterback should use in those parts of an actual gridiron are employed. The game is said to be excellent training for football squads, teaching the members the type of plays that are best at different stages of the game.

Coach Jones is shown at right, above, demonstrating game to Tom Lieb, football coach at Loyola University, Los Angeles.

FAMILY'S BICYCLE BUILT FOR FIVE

MEMORIES of the gay nineties with their bicycles built for two are evoked by a bicycle for five constructed by an ingenious family man of Berlin, Germany. His bike, however, has several advantages over the double bicycle of thirty-five or forty years ago, especially from the children's point of view. He fastened two ordinary bikes together with three steel tubes, two connecting the frameworks in front and in back, and a third linking the frames of the rear wheels.

In two loops of strong rope, suspended hammock-wise from the tubes connecting the frameworks, he hung a little boat. The canoe not only accommodates three children on a trip, but adds greatly to their fun when they reach the beach and sail in it.

There is no connection between the handlebars, which throws the responsibility for steering upon each of the riders. It was found, however, that with a little practice the movements of the front wheels could be synchronized so that there was no difficulty in making the turns. A difference of opinion probably would halt all advance.

Two bicycles clamped together, with tiny boat swung between them, makes ingenious carry-all for this Berlin family.

CADDIES IN WIRE ARMOR DEFY CARELESS GOLFERS

LIKE baseball catcher's masks which not only fit over the head but also cover the body, extending below the belt, are curious suits of wire armor worn by boys who retrieve golf balls on a new driving practice range at Los Angeles, Calif. The contrivance with which they scoop the balls into pails is a small wire net attached to a long metal handle.

Flying golf balls have no terror for the caddies wearing this defensive wire mesh armor.

THERMOMETER FOR AUTO

A THERMOMETER that can be pinned to the upholstery in an automobile shows the passengers the temperature during a ride. The instrument is operated by expanding and contracting metal.

This tiny, all-metal thermometer pins to the upholstery of an auto to show temperature.

NEW 37-POUND TALKIE CAMERA, SOUNDPROOF

WITH a weight of only thirty-seven pounds, a new soundproof talking motion picture camera has been developed.

It is mounted on a tripod and can be handled almost as easily as an ordinary studio camera. The new machine's soundproof qualities are necessary to keep out of the record all sounds that do not come directly from the microphone which picks up a speaker's voice. It is also fire- and waterproof, making it valuable for gathering newsreel material.

The light weight housing of the new camera is made of a transparent composition similar to celluloid. In the past, many of the soundproof cameras in use have been of a large "ice box" type, mounted in a heavy cabinet weighing 500 pounds and much like the standard home refrigerator in appearance.

Mounted on a tripod, this soundproof 37-pound talkie camera is designed for outdoor work.

BUTTERFLY WINGS TAKE PHOTO OF THEMSELVES

A MYSTERY that science has yet to explain is the curious fact that butterfly wings can photograph themselves in the dark, according to Austin Clark, of the U. S. National Museum, who discovered the phenomenon.

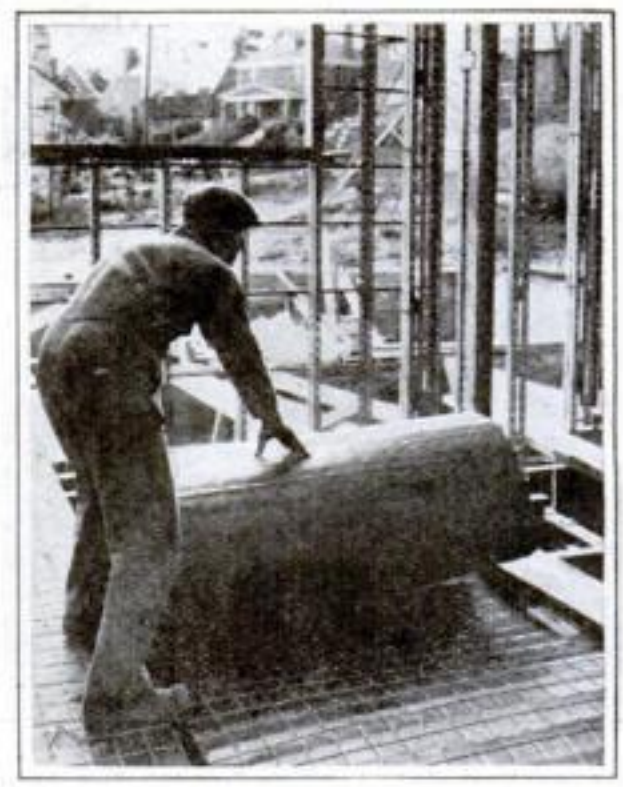
Clark mounted butterfly wings on paper and placed them in the bottom of a cardboard box. Then he laid a fresh photographic plate, emulsion side down, on top of the wings and put away the sealed box for a week. At the end of this time the plate had acquired a clear image of the wings, complete in detail and relative shading. Black patches on the wings came out black on the plate, and therefore white upon the print made from it. Exactly the opposite was true of white spots.

Thin strips of transparent cellophane between wings and plate ruled out the possibility that the effect was caused by contact with chemicals in the wings. The pictures appeared just the same with the cellophane, although glass and quartz prevented them.

WIRE-PAPER LATEST BUILDING AID

WIRE-REENFORCED paper is a new building product, used as a foundation for plastering and reënforcement with concrete floors. It is made by weaving heavy wire mesh into the surface of strong fibrous paper.

As a foundation for concrete flooring, the composition material is laid in long strips on the floor spaces and attached to the steel or wood beams by special clips. Wet concrete is poured over the material, and the wire mesh becomes embedded in the concrete, while the paper acts as an insulating and soundproofing aid. The process in using the wire-paper for plaster foundations is much the same.



Heavy wire mesh, woven into paper, is being used as a foundation for concrete flooring.

QUARTER-INCH LIGHT WORKS ON 110 VOLTS

A GIANT and a midget among electric lamps appeared together recently in one of the laboratories of the General Electric Company. A tiny neon light, a quarter of an inch in diameter, claims the distinction of being the smallest lamp ever made to run on the ordinary 110-volt household lighting system. Its big brother, one of the world's largest incandescent lamps, developing approximately 100,000 candlepower, is used for motion picture studio lighting.

The big and little among lamps is this quarter-inch neon and the 100,000 candlepower light.

WANT TUGBOATS TO USE LIGHTS, NOT WHISTLES

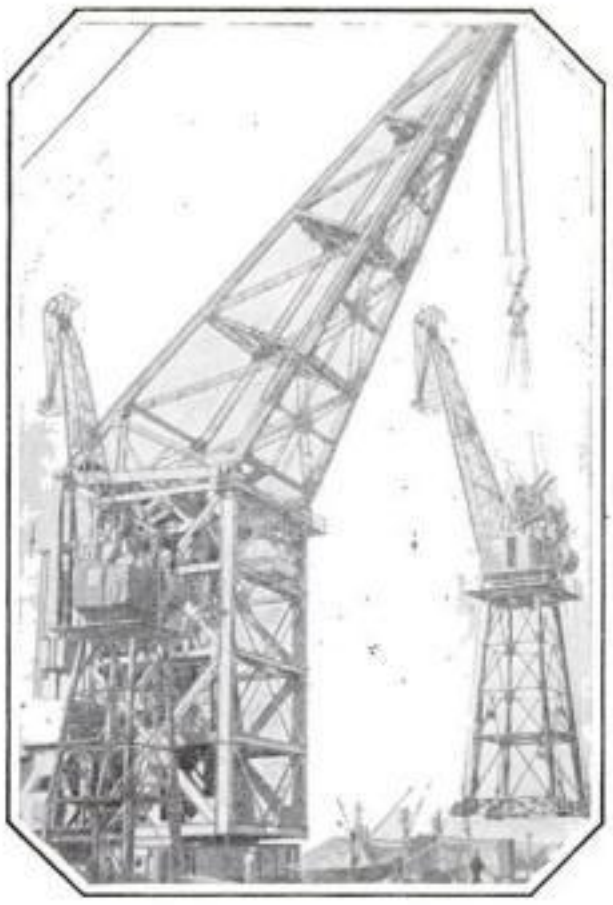
BLINKING lights instead of tooting whistles would enable river craft to communicate noiselessly with each other, in a plan proposed by the First Avenue Association of New York City.

Department of Commerce rules now provide that a steam vessel overtaking another and wanting to pass on the right shall give one short blast. If answered by another, the overtaking vessel shall change her course and pass on the left side. Flashes of white light could easily be substituted for the whistles, William W. Hoppin, president of the Association, told POPULAR SCIENCE MONTHLY. Men who pilot ships on inland waterways, he points out, are trained to look for the colored port and starboard lights of an approaching vessel and therefore would not miss the flashing white signals. In fact, they might be less confusing than whistle blasts, since in a crowded river it is sometimes hard to tell from what direction the whistle comes. Hoppin would amend the rules to provide for their use.

FRONT-WHEEL DRIVE USED IN 1908

THERE is nothing new under the sun, not even the front-wheel automobile drive. Back in 1908, the pioneer racer, J. Walter Christie, entered a front-wheel-drive machine in the Vanderbilt Cup races. Two cylinders were carried directly over the front axle. As the inventor of the recent "greyhound" Army tank that can charge over sand dunes and plowed fields at forty miles an hour and make sixty miles an hour on the open road (P. S. M., Nov. '29, p. 62) Christie evidently retains his zest for speed.

A rare picture of the first front-wheel-drive car ever made. It was built for J. Walter Christie for the 1908 Vanderbilt cup races.



BIG CRANE LIFTS LITTLE ONE IN TILBURY HARBOR

AN OUT-OF-THE-ORDINARY experience for a sixty-five-ton crane working in the Tilbury harbor, England, was to be hoisted itself and moved to a new position by a mightier derrick. The monster of 150 tons' capacity picked it up as easily as the little one handled bulky crates and cargo. The cranes are part of the equipment of a large British shipping concern.

LOUDSPEAKER HEARD 25 MILES AWAY

RESIDENTS of Berlin, Germany, recently listened to the strains of music from a loudspeaker twenty-five miles away. The speaker's voice was said to equal the volume of an orchestra of 2,000 pieces. Placed on a roof for the test, by a German electrical concern, it produced air waves that could be felt on the skin 150 feet away.

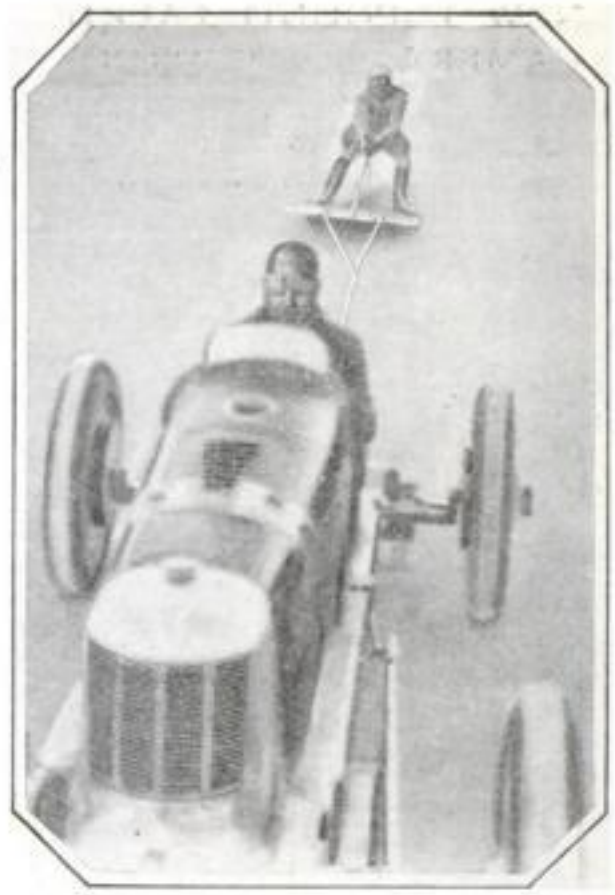
A current of 120 amperes was required to operate it. Its diaphragm vibrated a full inch to produce its voice.

FLEE DOWN GUY WIRE TO ESCAPE OIL WELL FIRE

RIDING a twelve-pound emergency slide, oil men who are trapped by fire high up on well derricks can make their escape down guy wires. This new slide was devised by Oscar Curley and R. Hecox, employees of the Standard Oil Company of California, and is now part of the regular equipment of that company.

When a derrickman goes aloft to work, he carries the portable slide on his shoulder until he reaches the place where the wires are fastened to the tower. Then he clamps the safety slide to a wire with the brake on and goes about his work. In an emergency, he can make a quick escape by slipping one leg through the metal leg sling and releasing the brake. When the rider nears the ground, he can slow down his speed by means of the brake lever.

Above, an oil well man slides to safety, using the new device that grips guy wire down which he shoots. At right, close-up of life-saver.



AQUAPLANING ON LAND IS NEW DARE-DEVIL STUNT

IF STEEPLEJACK-climbing and parachute-jumping begin to pall, here's a brand-new sport for thrill-seeking dare-devils—"aquaplaning" on dry land behind a speeding car. Recently Louis Moore, Los Angeles, Calif., racing driver, gave Douglas Harper a surfboard ride at seventy-five miles an hour over a dry lake bed near Muroc, Calif. A slight bump beneath the board, or a moment's loss of balance, and it would be all up with the rider.

"CAT'S CRADLE" FIGURES TRACE MAN'S MIGRATION

STRING figures, of which the familiar "cat's cradle" is a typical example, have proven clues, in the hands of modern anthropologists, in tracing the migration of primitive men throughout the world.

Many native tribes of Pacific islanders, Australians, and North and South American Indians have their own characteristic string figures. The games are commonest in the South Pacific, and comparison of them suggests that ancient South Pacific tribes, perhaps highly civilized, migrated to Australia and to the Americas, bringing their string games with them. No such pastimes appear in Europe or Asia.

TAIL CARRIED BRAIN OF PREHISTORIC MONSTER

DIPLODOCUS, one of the biggest animals that ever lived, thought with his tail instead of his head. That is where he carried his brains, according to experts of the National Museum who have just put the bones of one of these monster dinosaurs together.

However, they say, that did not make him any smarter. All of the giant lizards known as dinosaurs were more distinguished for their size than their mentality. This specimen was eighty feet long, and when alive, weighed about fifteen tons.

Probably millions of years ago he wallowed in a semitropical swamp now the mountains of northeastern Utah.

ROBOT FOR LIBRARY STAMPS CARDS

YOU may see a strange-looking metal box in your home free library one of these days. If so, it will be a new automatic register for books being withdrawn, which was exhibited recently at the convention of the American Library Association in Los Angeles, Calif.

When a book is taken out, the book card is given to the librarian at the desk. She inserts it in the automatic register and turns a knob. Automatically the date is stamped on the card and it is again placed in the book. The device is said to speed up the work of registering books, as the capacity of the robot is far in excess of that possible with the hand stamp and numbering now in general use.

The illustration at the left shows the date stamper being used in a public library.

The work of registering and issuing books in public libraries may be speeded by this robot which automatically stamps date on cards.

At left, the teletype machine used in assembling weather reports. Above, pilot in radio equipped plane hears report of what's ahead and tells how things are going with him.

Weather Man Makes the Air Safe

New Service Will Provide Hourly Radio Reports Along 13,000 Miles of Airways

By GEORGE LEE DOWD, JR.

Studying the weather tape. The message received from the teletype machine is printed on a strip of paper, not unlike the ticker tape.

PILOTS plying America's skyways from the Atlantic to the Pacific and from Alaska to the Hawaiian Islands will receive hourly weather reports and regular three-hourly forecasts in the form of radio bulletins and maps as soon as the U. S. Weather Bureau completes expansion of its special service in aid of aviation.

Congress recently granted the Bureau $1,400,000—more than one third the sum it spends annually for all of its work—for the purpose of making our airways safer for the flyer.

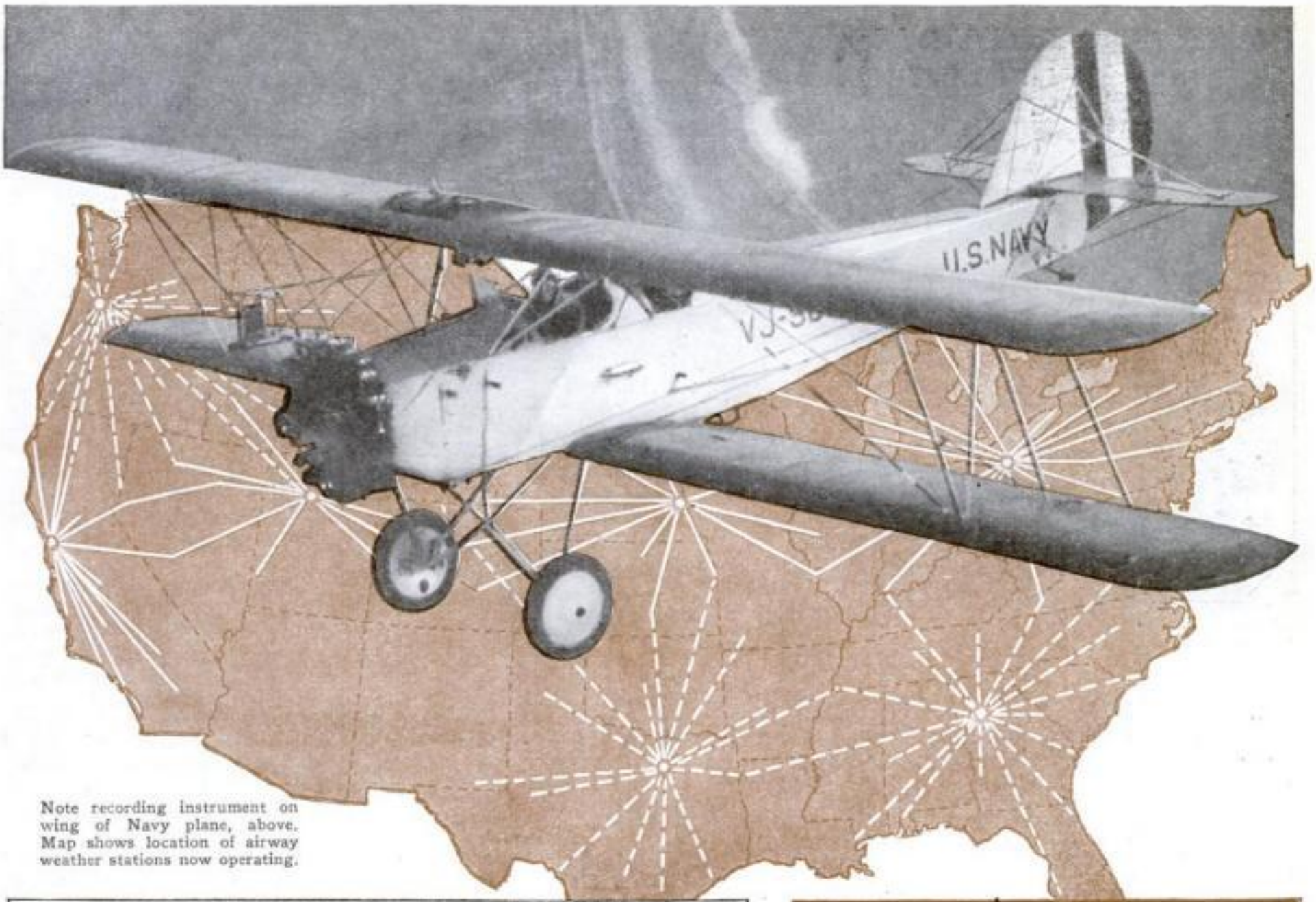
As this is written, the scope of the Bureau's aviation service has been extended considerably. Over approximately 13,000 miles of commercial airways, frequent and regular weather reports now are being issued. Along about 8,000 miles of them, a twenty-four-hour teletype communication system with exchange of reports every hour has been established. The other 5,000 miles are served by reports transmitted at frequent intervals by telephone and telegraph. In addition, a limited service is provided on nearly 3,000 miles of airways over which, as yet, there is comparatively little flying.

The hourly interchange of weather reports is made mainly by means of the teletype, the device which, through wire lines, automatically and simultaneously reproduces, at as many points as desired, messages written with the aid of an ordinary typewriter keyboard (P. S. M., Mar. '29, p. 23).

These reports are assembled at strategic places, where bulletins, giving the state of the weather, height of low clouds, fog, and visibility at all points on the airway, are issued every hour by radio. A majority of transport planes now are equipped to receive these radio bulletins while flying.

ASIDE from this hourly service, maintained chiefly by stations installed recently for the purpose, about 110 of the older Weather Bureau stations, both on and off the airways, now take and report observations every three hours, instead of only twice a day as formerly. Their reports are sent to seven forecasting centers, located at Cleveland, Ohio; Fort Crook, near Omaha, Neb.; Salt Lake City, Utah; Oakland, near San Francisco, Calif.; Atlanta, Ga.; Dallas, Tex.; and Portland, Ore.

The three last-named centers have been established since July 1. At these places maps are drawn and radio bulletins issued every three hours, day and night, reporting existing conditions and forecasting conditions for the next three hours along all airways in the surrounding territory. The broadcasts are made from a rapidly extending network operated by the Department



Note recording instrument on wing of Navy plane, above. Map shows location of airway weather stations now operating.

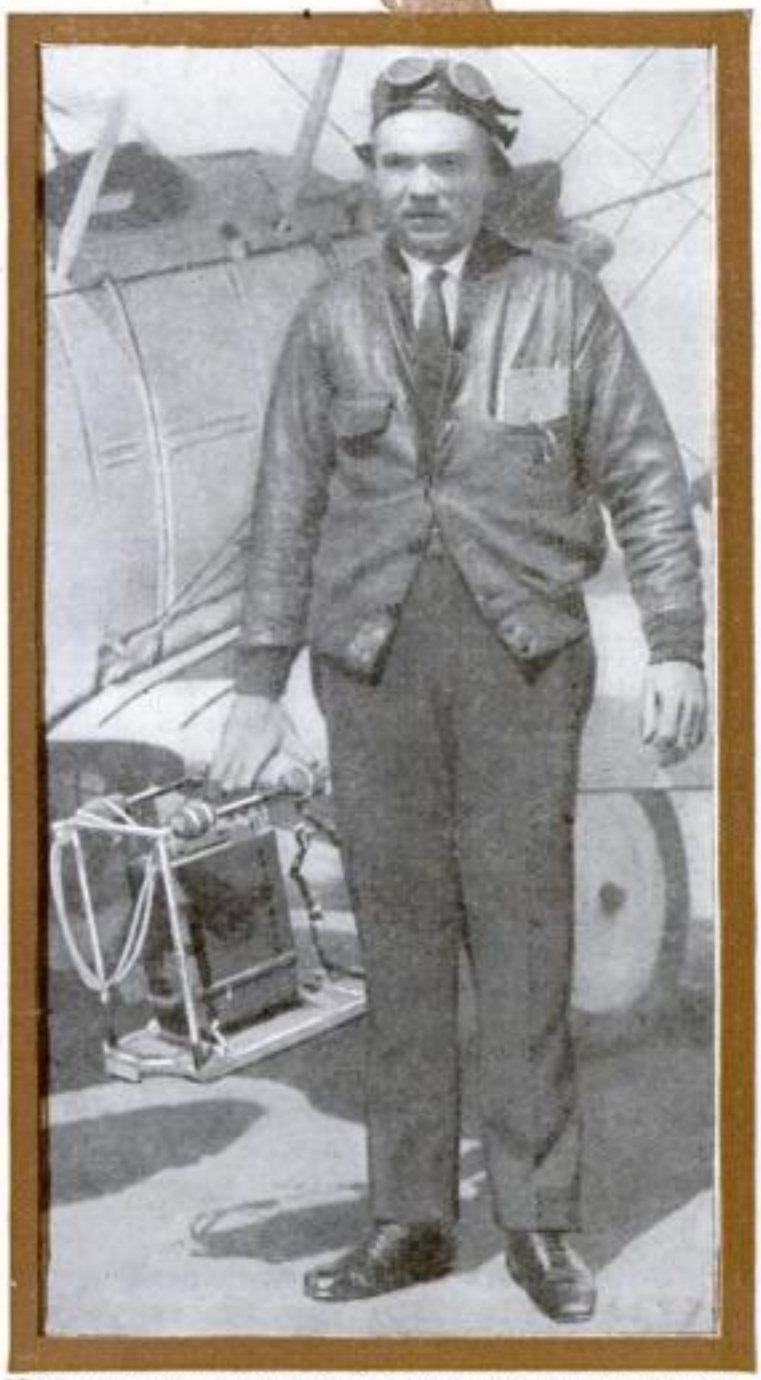
Hourly reports from distant points go to one of seven central stations and from there they are radioed to flyers who thus know exactly what kind of weather lies before them.

of Commerce, which now embraces about forty stations, and received by airports, landing fields, and aircraft in flight.

About four fifths of the total area of the United States now is covered by this intensive service, and in the course of a year it doubtless will blanket the entire country. The Weather Bureau's program provides for the establishment of observation from pilot balloons at several additional stations, including Albuquerque, N. M.; Cincinnati, Ohio; Dallas and Del Rio, Tex.; Elko, Nev.; and North Platte, Neb.

Besides, the Bureau is increasing its airways service in Alaska, where a new station has been organized at Nome. There and at Fairbanks, pilot balloons have been stationed. In the Hawaiian Islands, the service will include a chain of interisland stations, which will transmit radio reports to Honolulu, where they will be relayed to pilots flying from one island to another. Thus, not only the country itself but some of its territorial possessions as well will be covered by the service.

(Continued on page 158)



Every day Navy planes climb into the air to determine the weather conditions. This pilot is just back from such a hop.

At left Bowlus points out the aileron feathers from tip of pelican's wing, and above he studies these feathers, used by bird to maintain balance.

I Studied the Birds to Learn to Fly

By W. HAWLEY BOWLUS

For twenty years Bowlus went to school to the birds, those "greatest of all pilots of the air." Even today he is never without his spyglass, still trying to probe the secret of their tireless flight. In this article he tells you what he has learned and how this information can be used in the thrilling sport of flying a glider.

WHEN I was a small boy, I used to climb to the top of an old haystack and spend hours lying on my back watching the hawks and buzzards that spiraled on lazy wings in the blue sky above my father's ranch in the San Fernando Valley of California. I remember that I determined some day to build a machine that would carry me and soar. For twenty years I have been learning how. I have been going to school to the birds.

I have lost count of the number of live birds I trapped to study their wings. I made a large collection of stuffed specimens with which I experimented.

I have taken hundreds of reels of motion pictures of birds in flight. These I run slowly through the projection machine to note the action of the wings and the method of balancing. Even now, I never make a trip without taking along a spyglass and a home movie camera in the hope of learning something new about flying from these feathered masters of the air.

The sixty-foot sailplane that carried Jack Barstow on the longest motorless flight of history, a few months ago, was one result of this study. The birds are still the greatest of all pilots of the air, and we can learn much from them. Probably the most economical flying in the world, for example, is accomplished by the golden plover, which, according to naturalists, frequently makes nonstop flights of 2,400 miles on two ounces of fat.

My first step on the road to soaring was to shoot a buzzard. I was ten years old then and I thought the best way to begin would be to examine the structure of a soaring bird and the conditions under which it flew. So I killed two rabbits and placed them out in a field near the chicken house where I was working.

Day after day went by. The big birds sailed past apparently ignoring the bait. About the fifth or sixth day, I came to the chicken house and was delighted to see a large buzzard sitting on the ground near the rabbits. With my father's shotgun in my hand, I crept through the henhouse and lying flat on my stomach crawled through the tall grass toward the spot.

When I was as close as I could get without frightening the bird away, I took aim directly for its head so I would not damage the wings or body. Luck was with me, for the charge of shot completely knocked off the head but left the body untouched.

I took the bird to the workshop and stretched it out carefully on a board as near as possible in its flying position. While the wings were drying, I got my mother's tapeline and measured them. Their spread was seven feet three inches and their width ten inches.

The largest soaring bird of all is the great condor of the South American Andes with a wing spread sometimes as great as eleven feet. When the wings had dried, I attached a small piece of lead to the portion of the neck that remained in order that the loss of the head would not disturb the

With a movie camera, Bowlus takes picture of flock of sea gulls soaring over the sea off the California coast.

balance, and then took the buzzard to the top of the haystack. When I launched it into the breeze, it sailed downward just like a model glider traveling for some distance.

Of course, the body of the bird did not remain in very good condition for many hours. When my mother found me playing with the dead buzzard, which was anything but a rose garden, she suggested that I get rid of it as soon as possible. But before I threw the body away I dissected it to discover how the framework of the bones was constructed.

I WEIGHED each part of the bird and afterwards I built a small model of the body, using the same dimensions and weights. To this wooden framework I attached the dried wings. This model, with its feather-covered wings, flew splendidly, much to my surprise. It would sail far down a hillside and when I attached it to a string it flew as a kite, scaring the hens when I made it swoop over the chicken yard.

The weight of this first buzzard, I figured out, was about one and three quarters pounds for each square foot of wing area. The weight of soaring birds in general as compared to their wing area is light. A full-grown pelican, which appears heavy because of its large bill and pouch underneath, weighs only one and four fifths pounds for each square foot of wing surface.

The aspect ratio—that is, the number of times a wing is longer than it is wide—in soaring birds is always high. It runs from seven to fifteen. The albatross, greatest soarer of all, has the highest aspect ratio. In the construction of my sailplanes, I have copied this feature. Long, thin wings, I have discovered, are always most satisfactory. They cause fewer air swirls at the trailing edge. In wide wings, these swirls are pronounced and add to the drag which the craft must overcome.

Gulls skim top of waves as Bowius snaps them.

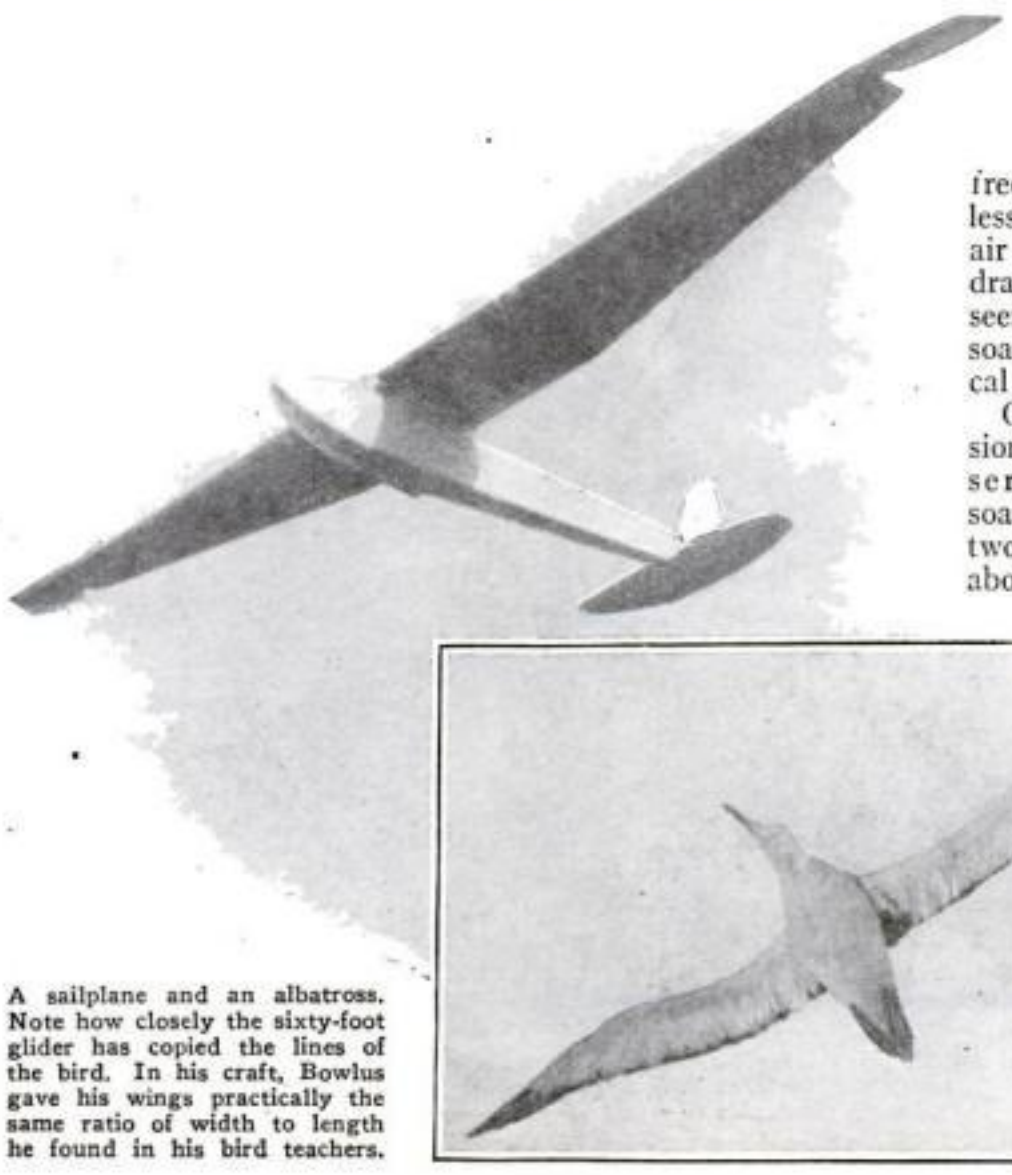
MOST of my early studies were made on buzzards because they were plentiful in the section of the country in which I lived. On trips to the beaches, however, I had a chance to study sea gulls and white pelicans as they soared in formation along the cliffs in the rising air currents.

Some soaring birds, notably the gulls and pelicans, use their wings a great deal for flapping flight. Buzzards and hawks, on the other hand, move their wings only infrequently. Regardless of how small the air currents and updrafts may be, they seem to be able to soar without physical effort.

On several occasions, I have observed buzzards soaring as low as two or three feet above the ground. Every second I expected them to use their wings to gain height. But they seemed to know just where the up-currents were and how to utilize them to gain altitude regardless of how low they might be.

Being able to maneuver quickly, these birds can climb gracefully on slight uprising air currents like those that come from the roofs of buildings, from sandy spots heated by the sun, and from the small whirlwinds that stir the leaves and dust on hot summer days.

I have watched buzzards soaring in such whirlwind, or convection, currents many times. They approach from any direction. As soon as they feel themselves being lifted, they swing in a wide, sweeping turn until they find the extent of the up-draft. Then they usually fly on the outer portion of the circular convection current, where they are able to make complete circles following the upward trend of the air.



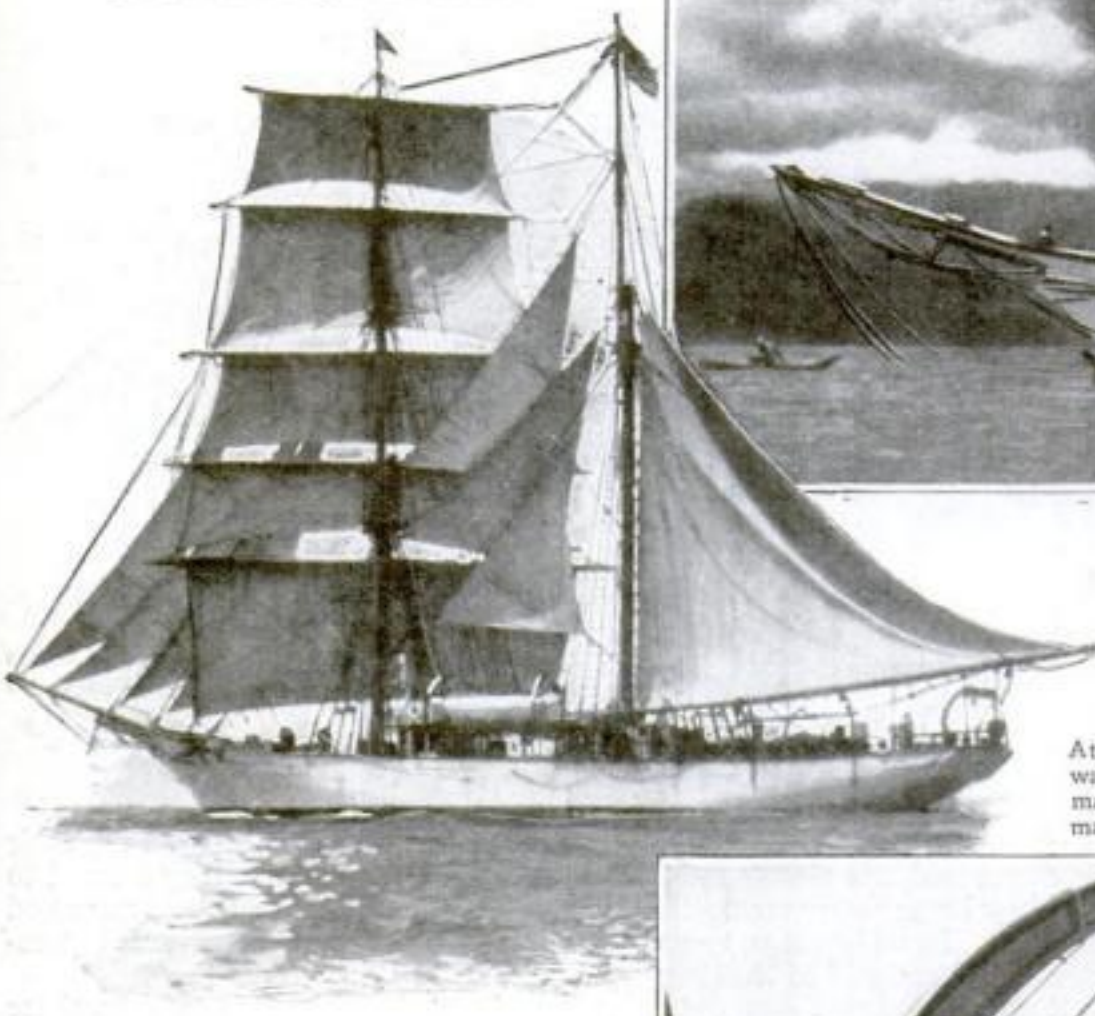
A sailplane and an albatross. Note how closely the sixty-foot glider has copied the lines of the bird. In his craft, Bowlus gave his wings practically the same ratio of width to length he found in his bird teachers.

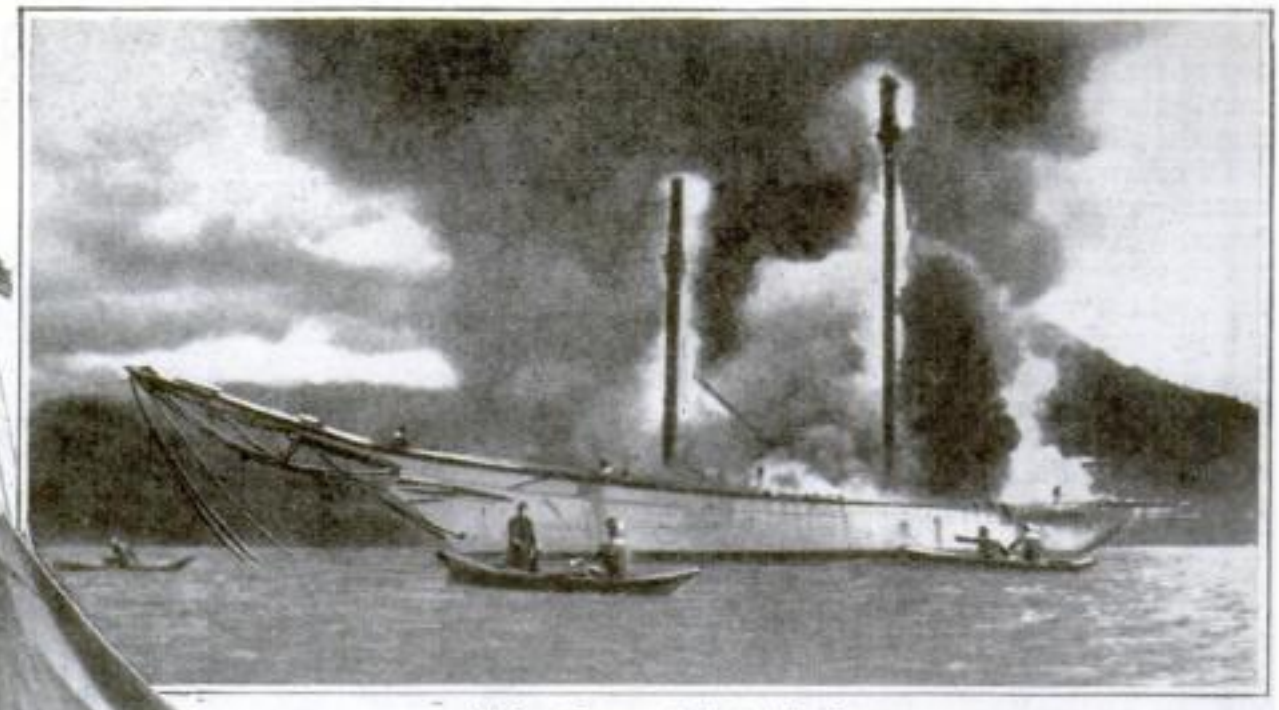
BIRDS have the advantage over man in that their light weight requires wings of only a few feet span to support it. Men must have wings from five to fifty times as long. Such wings cannot get lift from the small columns of rising air which support the birds.

At Point Loma, I once tried by releasing toy balloons to discover the places where the air was rising most rapidly. Sometimes, a balloon would shoot skyward as though in the grip of a powerful up-current. But when I flew over the spot in my sailplane, I got practically no lift at all. My conclusion was that the balloon had risen in a small column of heated air that was not big enough to affect the large machine. Birds, however, can make use of such up-currents.

Pelicans and gulls usually do their soaring along the cliffs in the up-currents formed by the ocean breezes striking the promontories. They seem to fly in squadrons with a leader who is responsible for the amount of work done. A hundred times I have seen the same thing occur. When the leader of a long line of pelicans would make a stroke with his wings, all those following *(Continued on page 154)*

VAST DEATH BELT IN SEA FOUND BY *CARNEGIE*





While taking on fuel at Apia, Samoa, the nonmagnetic yacht, *Carnegie*, was destroyed by an explosion that cost the life of her commander. All of the scientific data were saved.

At left, the *Carnegie*, which was built to study the earth's magnetism and in which no magnetic material was used.

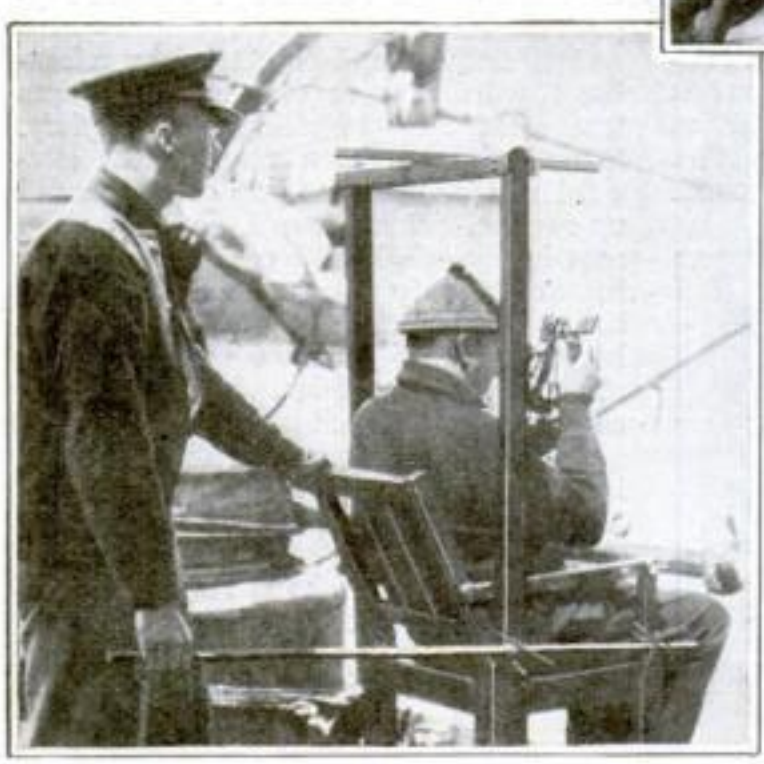
At left, dropping a bottle into the sea to get sample far below surface. Above, a bottle of the deep-sea water.

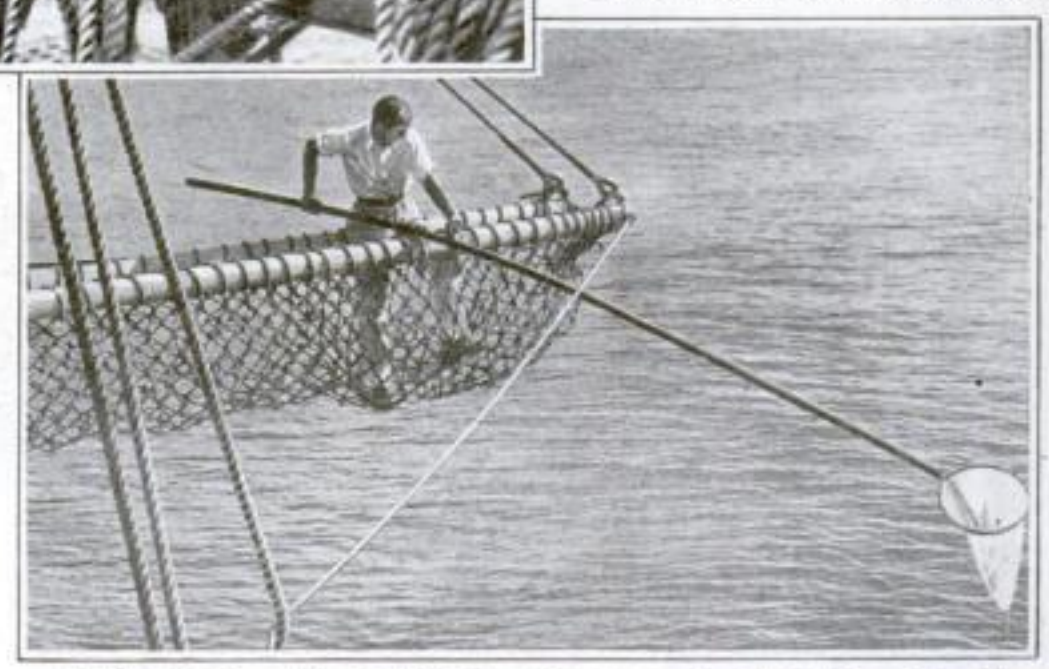
A VAST death belt in the Pacific was the last discovery of the strange "nonmagnetic" yacht *Carnegie* before the explosion that ended her career.

Just made public by her navigator, O. W. Torreson, the results of the last cruise of the ship were a fitting climax to the 350,000 miles she has voyaged with scientists of the Carnegie Institution of Washington.

No vessel exactly like her had ever sailed the seven seas. Every piece of metal in her had to be free of magnetic materials.

On her last cruise, scientists aboard her found a "death belt" in the Pacific, an area a hundred or more miles long where nothing could live beneath the waters. Beginning at a depth of 300 feet and extending down for a quarter of a mile, the water contains no oxygen, which is required for life by every creature.





At left, the *Carnegie's* captain follows the course of a pilot balloon released in study of air currents. Above, a scientist in the net between 30-foot booms, extending from the ship's side to escape vessel's wash, dips specimens out of the Pacific.

Saving *Runaway* Farm Lands

Nation opens campaign to aid farmers and end the yearly loss of $200,000,000 worth of rich soil that now races into the sea. Terraces and dams to curb erosion.

By

CHARLES FITZHUGH TALMAN

In Panola County, Miss., water has worn out this deep and wide gully through the heart of a valuable farm. This is a striking illustration of the destructive power of erosion. It is against loss of this sort that a nation-wide soil preservation campaign is being waged.

IT IS no new discovery that some of the best agricultural soils of this country are rapidly slipping away—down the hillside into the streams, down the streams to the ocean. Agricultural authorities estimate the loss to the farmers of the nation as at least $200,000,000 a year. Now, at last, something is to be done about it! A nation-wide campaign has been launched for the preservation of the soils of the United States from the direful effects of rain erosion.

Last year Congress appropriated funds for the establishment of experiment stations in different parts of the country, at which all phases of this destructive process will be studied and methods of checking it will be devised and tested. Similar studies have been conducted in a half-hearted way by Federal and State agencies. Henceforth they will be made in accordance with a national program under the direction of a central committee. This committee will be composed of Federal and State representatives.

A general survey of the country, recently carried out by the United States Bureau of Chemistry and Soils, determined the regions in which erosion is most serious. Eighteen of these regions, each with its peculiar problems, have been selected as sites of experiment stations. Three stations were established in these localities during 1929, and three more will be in operation before the close of the present year.

THE urgent necessity for such measures has often been pointed out. The importance of soil erosion as a national problem was a subject of discussion at the conference of governors held at the White House in 1908 to consider plans for the conservation of natural resources. Long before that, the results of the process were evident in certain agricultural regions. Even before the Civil War, whole townships in the cotton belt had been robbed of their fertility and converted into sandy wastes by the washing of rains.

Rain water, scouring the countryside, rushing down hillsides, gouging out gullies and sweeping over gentle slopes of cultivated fields, carries away hundreds of millions of tons of soil every year. According to one recent estimate, the amount of soil material annually transported to the sea is upwards of 500,000,000 tons, and a vastly larger amount is deposited on lower slopes, flood plains, and river beds, where, in general, its presence causes havoc only second in importance to that wrought by its removal from higher lands. The mere effect of erosion in silting up navigable streams is a serious problem.

The greatest evil, however, lies in the damage done to cultivated lands by the removal of the surface soil. This is the humus layer, the part from which plants get their principal nourishment. When it is washed off generally a clay subsoil

Wind and water joined forces to sweep away the rich vegetable-growing loam from this Madison County, Miss., farm. Only the clay subsoil remains in place.

Terracing would have saved this farm. Note how the surface waters have washed sand down from the hillsides and to a considerable extent covered the rich soil—the farmer's one asset.

Figures above show the two types of terracing widely used in Europe to prevent erosion. The upper is the older form, suited to hilly farms.

Terracing a Missouri farm. It is thus that runaway land is kept where it belongs.

is exposed, which is difficult to till and far less fertile. H. H. Bennett, of the Bureau of Chemistry and Soils, United States Department of Agriculture, the leading American authority on soil erosion, estimates that the amount of plant food which is removed by this process every year from the farms of the United States is not less than 126,000,000,000 pounds, or about twenty-one times as much as is extracted annually from the soil by crops.

Not only are the fields thus impoverished, putting the farmers to great expense for fertilizers, but millions of acres have been completely ruined. The area of land rendered unfit for cultivation by erosion in this country up to the present time is said to be equal to the total area of arable land in Japan.

Machine with which terraces are built. Note that it is really a big plow with rolling coulter and an extremely wide share.

A startling example of the devastating effect of water. Note depth of gully as shown by the height of the tree's exposed tap root.

All farms in rolling or hilly country are more or less subject to erosion, which occurs in two distinct ways. The more familiar of these is the formation of gullies, which not only damage a farm by the removal of fertile soil, but also make fields more difficult to cultivate; besides, in many cases, encroaching on highways and undermining buildings, bridges, and the like. Gullies may start as natural depressions in a hillside, but they are often due to human activities. The cultivation of land directly up and down a slope or the driving of a wagon down a hillside when the ground is soft are among the common ways of starting gullies. Once started, they grow rapidly.

Less conspicuous, but eventually much more harmful, is the slower process called "sheet erosion," by which, during each shower, a film of soil is removed from the entire surface of a slope. This insidious type of washing is often quite unrecognized by farmers, who attribute the resulting impoverishment of the soil to the effects of crops. Both kinds of erosion vary in severity with the character of the soil, the amount and nature of the vegetative cover, the steepness of slopes, the amount and intensity of rainfall, and other factors, so that the process is quite complex and the problem of prevention equally so.

Some practical methods of checking erosion were evolved in the Old World centuries ago and are now in fairly widespread use. Since erosion is due to the rapid movement of rain water over the surface of the ground, methods of preventing it must cause the water either to sink into the soil or flow away slowly to a drainage channel. Deep plowing and various other methods of making the soil more permeable check erosion by diminishing the surface runoff. Vegetation protects the soil not only by binding it with roots but also by breaking the force of the falling rain, making the soil more absorptive, and obstructing the surface flow of water. Hence sloping fields should be kept covered with growth of some kind.

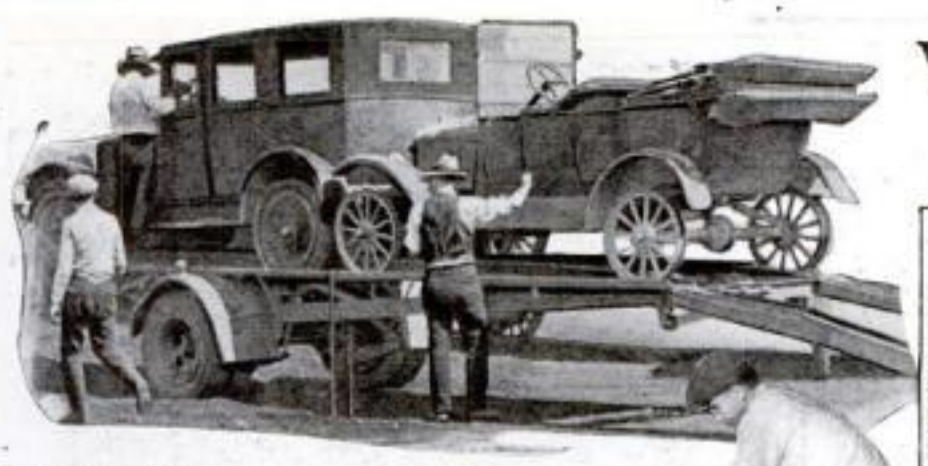
"CONTOUR plowing," which consists in breaking the ground along level lines across the slopes, reduces the flow of water downhill. In planting and cultivating the crops, the same level lines are followed, so that a shallow trough is made above each row. Most of the rain water is caught and held in this trough until it either evaporates or soaks into the ground.

Terracing is the most effective method of preventing erosion. The cutting of terraces in hillsides in order to retard the flow of water was practiced in ancient times, not only in Europe and Asia but also in South America, but methods of construction have been much improved in recent times in this country. The once universal type of terracing consisted of a series of regular benches or steps in the hillside.

The so-called ridge terrace is now preferred in the United States to the bench terrace, except on steep slopes. Ridge terraces form a series of ridges with depressions between them, which collects the rain water and prevents it from flowing directly down the slope. The ridges may be built either level or with a gentle slope, to conduct the water at low velocity around the side of the hill to an outlet channel.

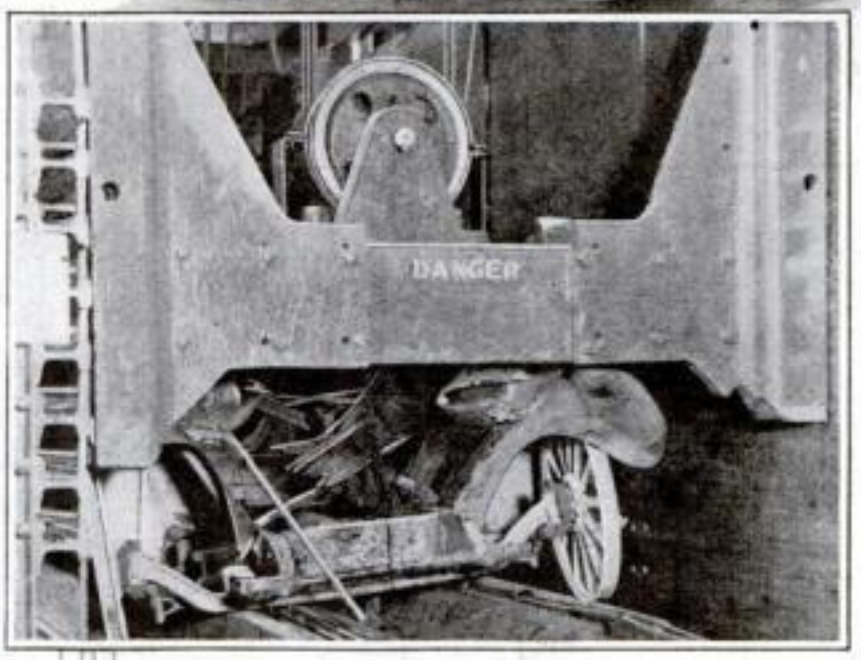
Terracing was, *(Continued on page 147)*

Where the Old Car Meets Its End and Starts Life Over Again

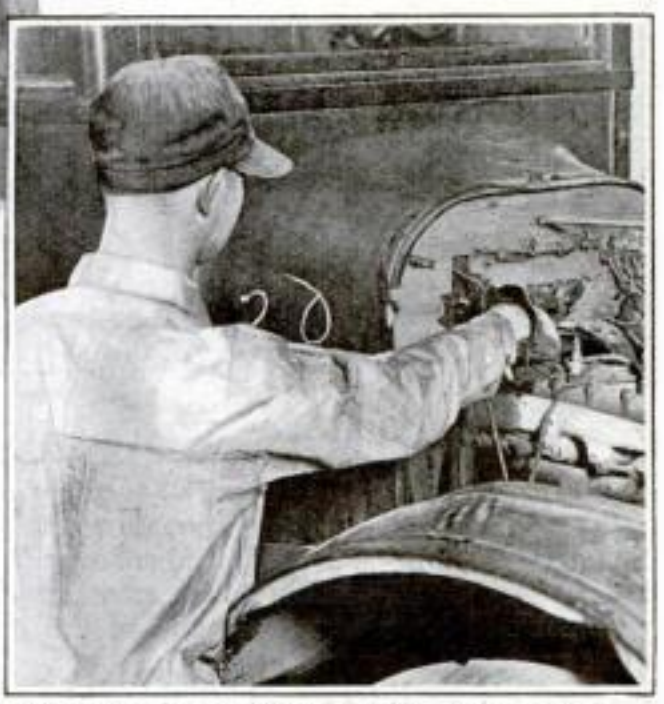


HOME AT LAST. Derelict cars from far away find final resting place at Henry Ford's Dearborn plant for auto reclamation.

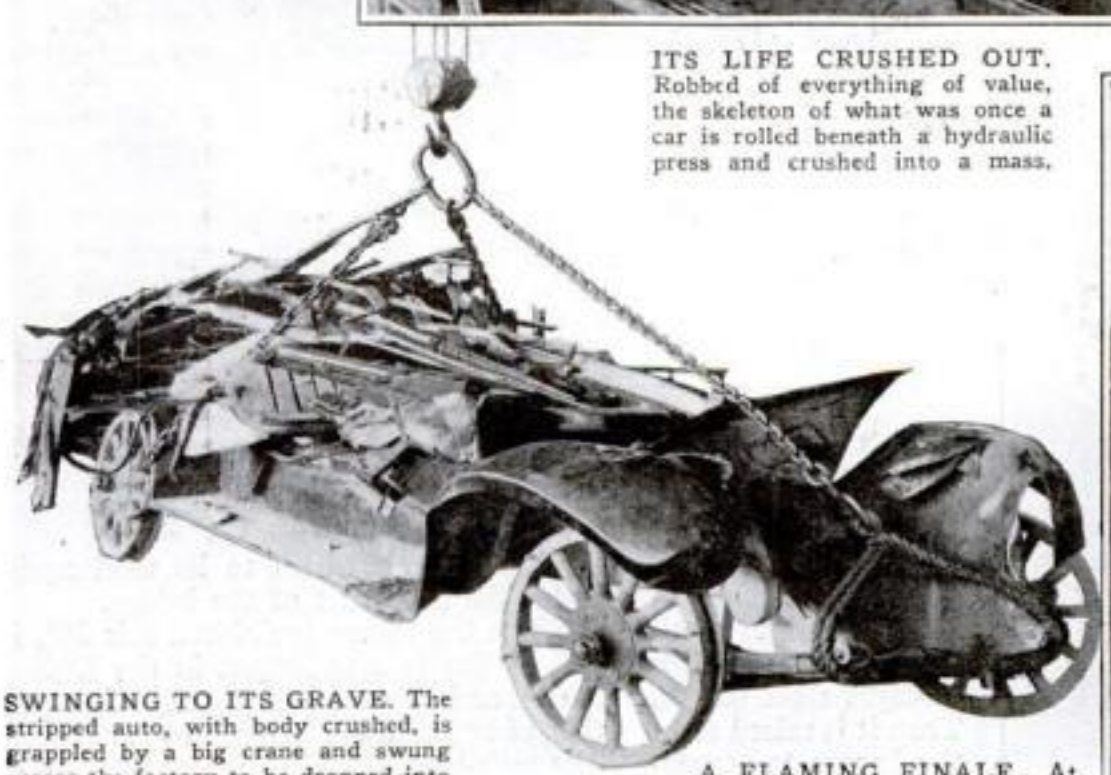
AT THE END OF THE ROAD. Just a junk heap of cars. Here thousands of worn-out autos are stored at Ford's Dearborn plant.



TAKEN FOR A RIDE. At the reclamation plant the machine is placed on a moving conveyor along which it travels while the crew of 120 dismantle it.



EVERYTHING IS SAVED. The horn, ignition wires, spark plugs, headlights, floorboards, even the grease, are removed. The boards go to a box factory; upholstery to the blacksmith's for aprons.



SWINGING TO ITS GRAVE. The stripped auto, with body crushed, is grappled by a big crane and swung across the factory to be dropped into the white-hot melting pot. Thus the last bit of the old car is salvaged.

ITS LIFE CRUSHED OUT. Robbed of everything of value, the skeleton of what was once a car is rolled beneath a hydraulic press and crushed into a mass.

A FLAMING FINALE. At right, the melting pot into which the car goes. Pig iron comes out.

AMERICANS NOW EXPLORING EGYPT'S OLDEST PYRAMID

A FEW dozen miles south of Cairo, at Meydum, Egypt, a steady supply of cut blocks of limestone arrived along a causeway from the river Nile, across which they had been floated from near-by quarries. Swarthy gangs of men hoisted them into place on the face of a step-backed structure of rubble. Thus the groups of men were hastening to complete, in honor of their King Seneferu, the first structure of its kind ever built, a perfect pyramid, 300 feet high. Among the spectators, perhaps, were scribes taking notes, for this was a remarkable engineering feat in any day, and particularly noteworthy in the year 4750 B. C., more than six thousand years ago.

This is the scene that has been reconstructed from discoveries made by a University of Pennsylvania expedition which is exploring the ancient structure. First found by modern man in 1881, the Meydum pyramid was reburied to save it from the depredations of tourists and native pilferers. Recently, however, the University of Pennsylvania obtained permission to excavate, measure, and examine it.

To reach the outer face, members of the expedition clambered perilously up ropes and crawled along blocks of stone with only slim cracks for a foothold. Within the structure foul air was another danger, and in the innermost chamber the men could remain for only one hour.

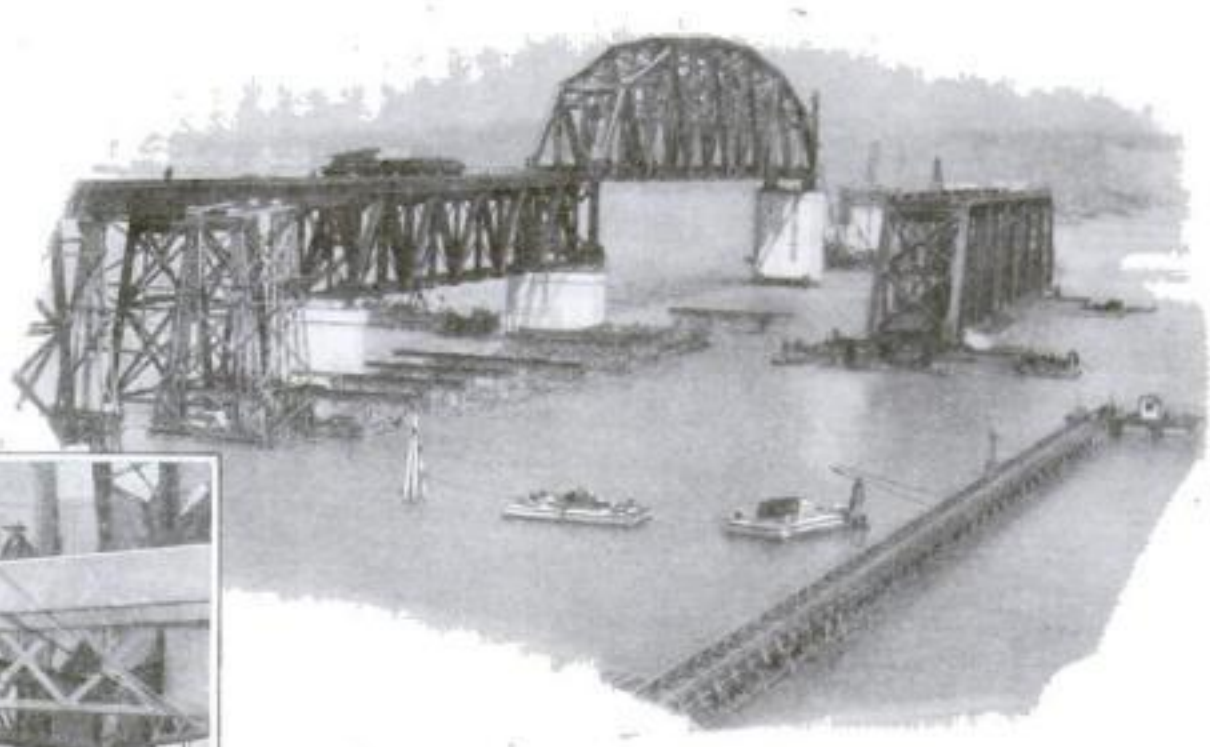
One discovery was a causeway of brick by which pilgrims could visit the temple. The explorers found messages scrawled on the inner pyramid walls by visitors of many thousands of years ago.

Dangling over the sides of the pyramid, suspended by flimsy ropes, a member of the University of Pennsylvania expedition is measuring the stones on the north face of the 6,000-year-old Egyptian structure.

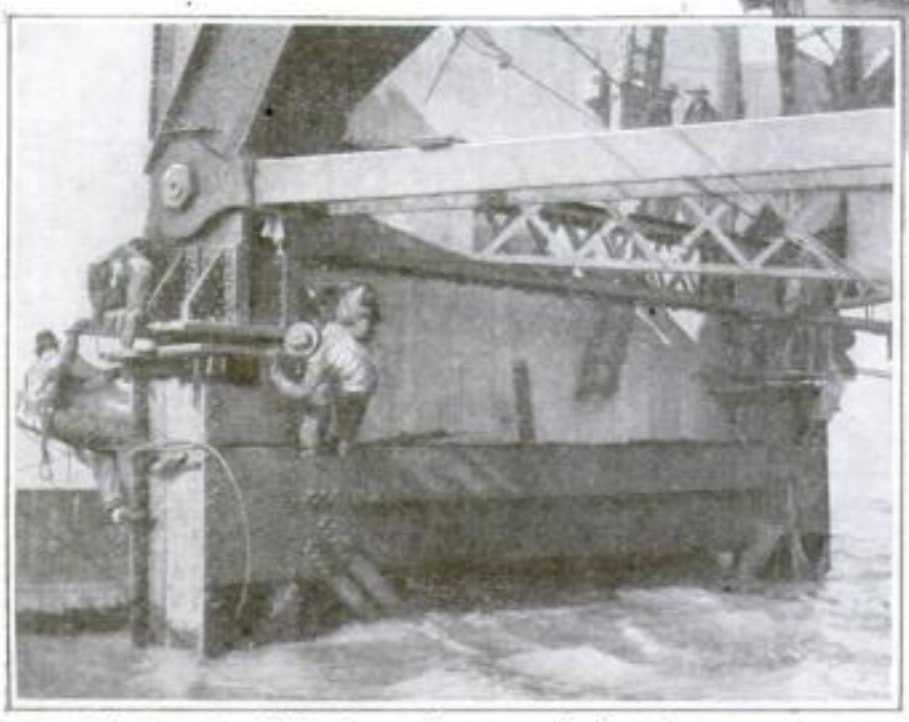
At left, Egyptian workmen are clearing the approaches to the Meydum pyramid and excavating the remarkable works discovered fifty years ago and reburied to save them from depredation by tourists.

Floating Span Is Used as Big Railroad Bridge Rises in West

WHEN the last section of the new Southern Pacific Railroad bridge over Suisan Bay, Calif., reaches its final resting place, it will have completed one of the most remarkable journeys ever made by a bridge span. Built on top of wood piles in the bay, it is being floated into each of the open-water gaps between piers. There is serves as falsework while a permanent span is built on top of it. The meandering span saves the cost of driving thousands of wooden piles to support the half-completed sections of the great bridge.



Resting on great steel barges, the 1,800-ton span is floated from under the permanent section and moved over for the next step.



Speed is the order of the day as the men make fast the temporary span on supports along the main pier, while Suisan Bay bridge is built.

With the tide aiding, the 1,800-ton-span is floated into position on top of two air-tight steel barges. Then it is raised from the barges to temporary supports alongside the piers. When the bridge section is completed, the floating span is moved on to be used again under the next part of the bridge.

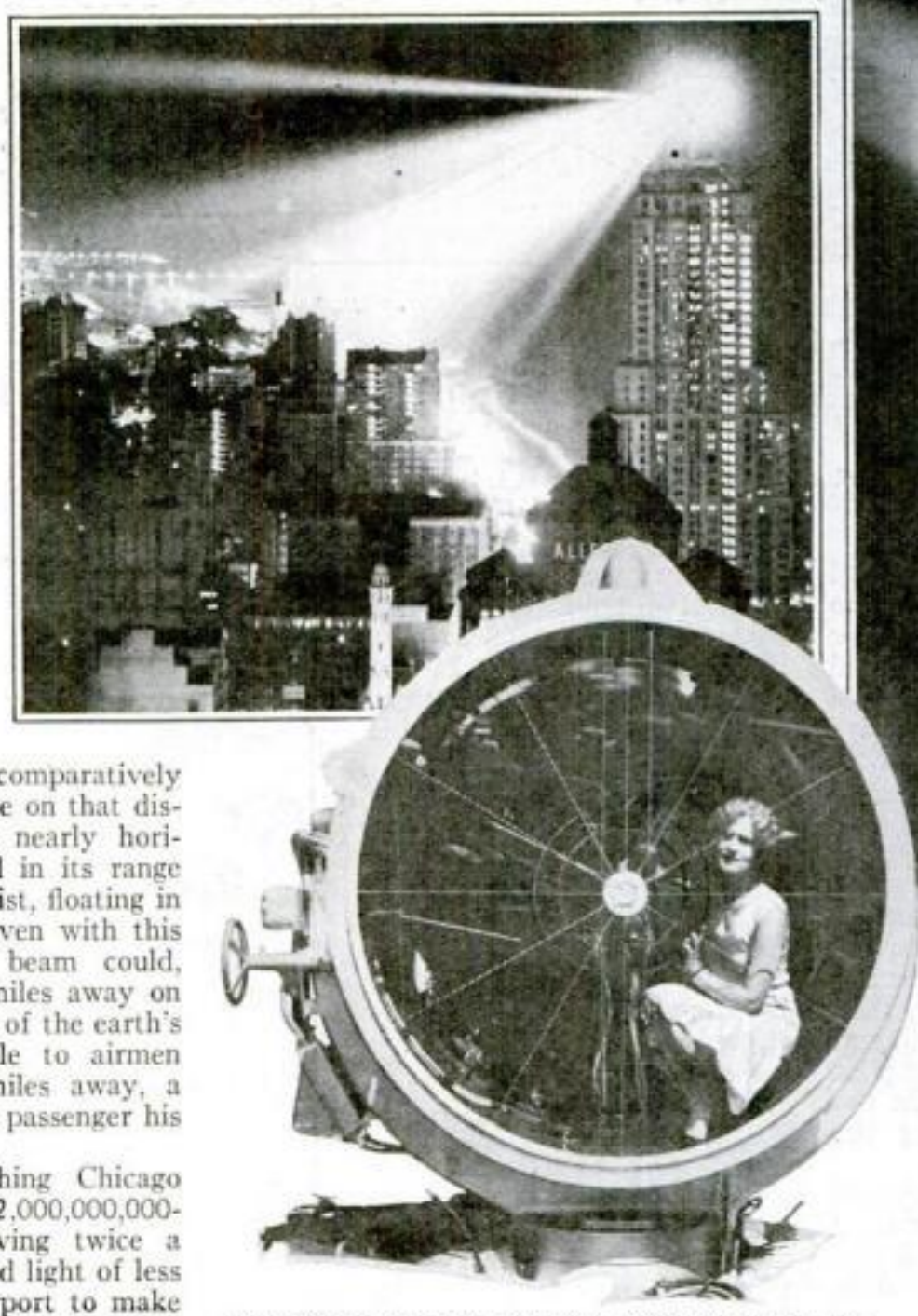
When the bridge is finished this fall, it will be the twelfth largest in the United States, and its carrying capacity will equal that of any railroad bridge in the country. The mile-long, double-track structure will replace the world's largest ferryboats, which now carry trains between Port Costa and Benicia, Calif., on the railroad's main line.

AIR LIGHT VISIBLE 300 MILES AWAY

A MAN standing on the moon could see with his naked eye the rays of an air beacon recently installed atop a Chicago skyscraper, if it were pointed toward him. To his eye it would appear like a star of the fifth magnitude, just large enough to be plainly visible, and he would notice distinctly when it was turned on and off.

Understood to be America's most powerful searchlight, the Lindbergh beacon will guide aviators approaching the hub of America's air line routes. It will not be pointed, of course, toward the moon, in which case its rays would have to penetrate only a comparatively thin layer of air to be visible on that distant satellite. Instead, its nearly horizontal beam will be limited in its range by the way that dust and mist, floating in the air, scatter its light. Even with this blanket to penetrate, its beam could, theoretically, be seen 500 miles away on the earth. Actually, because of the earth's curvature, it will be visible to airmen within 300 miles. Fifty miles away, a flyer could read a map, or a passenger his newspaper, by its light.

Air mail flyers approaching Chicago will spot from afar the 2,000,000,000-candlepower beacon, revolving twice a minute. Just below it, a fixed light of less power is focused on the airport to make landing easy. Within the larger beacon a battery of electric arcs furnish the light.



Above, Chicago's great air beacon, the light of which can be seen 300 miles away. In circle, a girl inside the light.

Close-up of America's biggest beacon. It is so powerful that its light would be visible to one on the moon.

AIR EXPRESS MAY SPAN CONTINENT

A TRANSCONTINENTAL "pony express air service" to carry mail and express across the continent in thirteen to fifteen hours was proposed recently by Capt. Frank M. Hawks, holder of all cross-continent speed records. He had just raced his Lockheed plane from Glendale, Calif., to Valley Stream, N. Y., on the Atlantic coast, in twelve and a half hours. This time included three refueling stops.

There is no reason, Hawks says, why relays of fast planes placed at strategic points cannot conduct a speedy service on regular schedules. Bankers and others interested in fast transport of interest-bearing securities and important documents might find such a service invaluable.

Off for the gliding field, carrying propeller and tiny twenty-two-pound ten-horsepower motor for the glider.

NEW GLIDER MOTOR WEIGHS 22 POUNDS

So COMPACT and simplified that it weighs but twenty-two pounds, a new motor for gliders is called the "outboard" motor of aviation. It is even easier to carry from place to place than the lightest two-cylinder types of portable motors for water craft. The lightest of such motors weighs twenty-nine pounds and is capable of developing only about three horsepower.

Designed for use with the light "powered gliders" now gaining popularity, the motor develops ten horsepower at 6,000 revolutions a minute. Its propeller is geared down to operate at 1,560 revolutions. The owner of the miniature power plant can tuck it under his arm, carry it to the air field, and readily install it in his glider for a flight. A Los Angeles engineer perfected the motor. With the rapid growth of glider clubs in the United States during the past year a demand for a powered glider has arisen, and this new light motor is designed to meet that need.

CURTISS HELICOPTER RISES IN SECRET TEST

ONE question that has been raised concerning the new Curtiss helicopter has now been answered. It can go up. In secret tests held recently in the hangar at Valley Stream, N. Y., the plane is reported to have risen several feet from the floor. A more thorough test is scheduled for a future date.

The Curtiss helicopter, built from the designs of Maitland Bleecker, is the first craft designed for vertical flight to be built by a prominent American airplane concern. As described in a recent issue (P. S. M., Sept. '30, p. 20), it resembles a forty-seven-foot windmill, its four revolving vanes sustaining it in the air. Such a craft could land in back yards and on roof tops, provided it can balance and propel itself in the air.

PLANE BATTERED BY HAIL

Caught in a South Dakota hailstorm, this plane was so badly pelted that it looked as though a machine gun had been after it. Ninety-five patches were needed to repair lower wing.

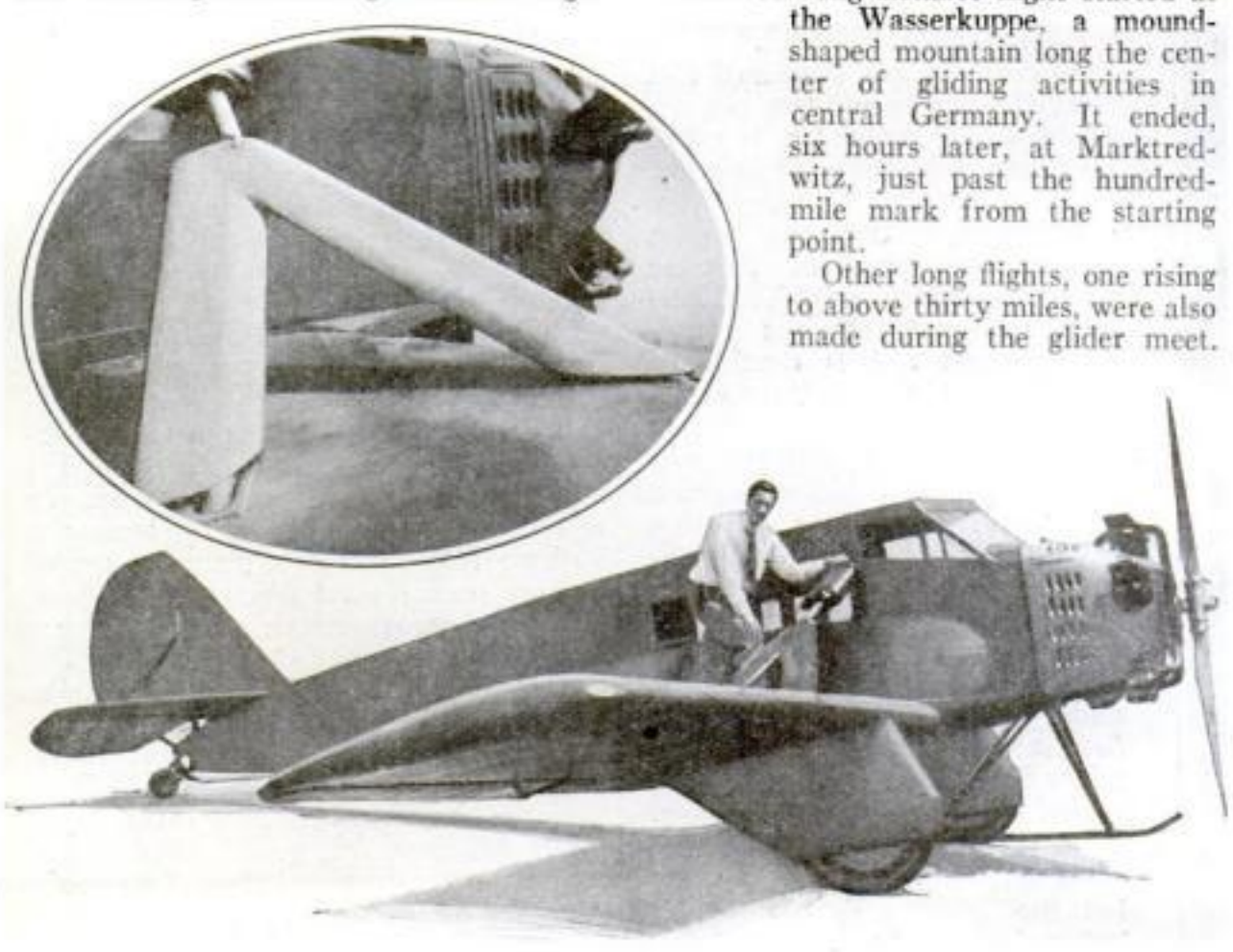
AFTER a South Dakota pilot encountered a hailstorm, the other day, his plane looked as if it had been a target for machine gun fire. Repairs gave its riddled wings the patchwork appearance seen in this unusual photograph. It took ninety-five patches to fix the lower right wing.

Ordinarily a pilot will avoid a hailstorm if he can fly around it, since serious damage to the control surfaces would be likely to cause a crash. In this instance, however, the pilot was unable to escape but his plane rode out the storm.

TILTING WINGS ABSORB AIR SHOCK

HINGED wings that can be tilted in flight are an innovation in an unconventional airplane designed by a western airport manager. In normal position, they form a straight line as in any standard low-wing monoplane. But when the pilot wishes, he can tilt them upward in the shape of a broad "V," changing the behavior of the craft completely.

The tilting wings serve three purposes. When controlled by the pilot, they alter the flying angle of the surfaces and hence the plane's speed and climbing rate. Able to respond also of their own accord, they act as shock-absorbers when the plane hits air "bumps." Lastly, in landing the pilot can tilt the wings upward, together with the landing wheels attached to them, thus lowering the fuselage until a huge skid grazes the earth and brings the plane to a quick stop. This third use, which actually turns the wings into a brake, is considered especially important.



Tilting wings control this novel airplane's speed. They also are adjusted automatically to absorb air bumps, and they can be operated as a skid brake. Insert is close-up of strut and shock absorber.

GLIDER SAILS 101 MILES

AN UNBROKEN flight of 101 miles over the Rhoen Mountains of Germany recently set a new world's record for nonstop glider piloting. The soaring champion, Robert Kronfeld of Austria, thus broke his own previous record of ninety-three miles, made ten days before.

The new long-distance flight started at the Wasserkuppe, a mound-shaped mountain long the center of gliding activities in central Germany. It ended, six hours later, at Marktredwitz, just past the hundred-mile mark from the starting point.

Other long flights, one rising to above thirty miles, were also made during the glider meet.

PILOT'S MAP IN CASE PROTECTED FROM WIND

A NEW aid for pilots in open-cockpit planes safeguards maps from being torn in the wind or lost. This device, a glass-covered map case, holds the map on a reel. Turning cranks brings into view any desired sixty-square-mile area along the pilot's course. The device was invented by Capt. W. B. Voortmeyer, U. S. N. R., of the Oakland, Calif., municipal airport, who charted the route for the famous trans-Pacific flight of the airplane *Southern Cross*. The case is large enough to hold a strip map of the entire United States. It is designed, especially, for the use of pilots who are flying a scheduled course and who, by means of it, can constantly check their route.

This case is designed by Capt. W. B. Voortmeyer of Oakland, Calif., to hold map in open-cockpit planes.

NEW BOMBER CARRIES GUNNER BEHIND RUDDER

OUT on a platform behind the rudder sits a machine gunner, in Great Britain's newest night bombing plane. His job is to repel attacks by plane from the rear.

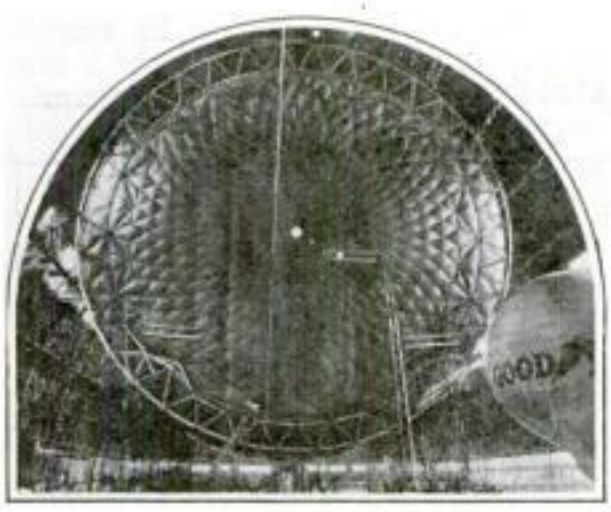
The innovation in British aircraft is believed to remove the one vulnerable spot on a bomber. Formerly it was a favorite plan for attacking craft to "sit on the tail" of a bomber and pepper it with machine gun fire. Under the new plan, the bomber can fight back effectively. This probably will lead to the development of a new line of attack on bombers and may radically change the entire system of air combat that is at present in general use.

PILOT USES LANDING LIGHTS AS RUDDER

USING his landing lights as a rudder was a recent stunt of John Murray, pilot of a Boeing mail plane flying between Chicago and Omaha. The lights were adjustable, and could be protruded from the wing. After setting the plane steadily on its line of flight, Murray found that he could steer it gently to left or right by adjusting the landing lights alone, and without making any use of the rudder pedals. Thus he could compensate for minor deviations in wind currents and hold a straight course.

BIGGEST AIRSHIP GETS ITS FIRST HELIUM CELL

WITH the installation of her first gas cell, a helium container that dwarfs in size a pair of balloons tethered in the hangar near by, the Navy airship *Akron* begins to look like a flying craft. The recent installation was made in the giant airship hangar at Akron, Ohio, where the craft is now half finished. It is expected to be completed by July, 1931. When finished, it will be by far the largest airship in the world. It will hold six and a half million cubic feet of gas, three times the capacity of the Navy airship *Los Angeles*. Its length of 785 feet will exceed that of the German *Graf Zeppelin* and the British *R-100*, as will its speed and cruising range. It will be able to fly two and a half times as far without refueling as the *Los Angeles* can.



The world's biggest airship, the *Akron*, now being built in Ohio, gets its first helium gas cell.

BALLOONS GIVE CITY GAS WHEN PIPE LINE IS CUT

Two 35,000-cubic-foot racing balloons came to the rescue at Ravenna, Ohio, the other day when workmen cut and repaired the city gas line.

Repairs were needed on a main pipe line and it was found necessary to cut the pipe. But housewives cooking their noonday meals never knew of the shut-off pipe. Officials of the gas company pressed into service the two balloons, which were inflated to a considerable pressure. Then the balloons supplied gas to the city until repairs were complete. A compressor maintained the necessary pressure in the line during the novel experiment, the first of its kind. Now gas men see a new use for balloons.

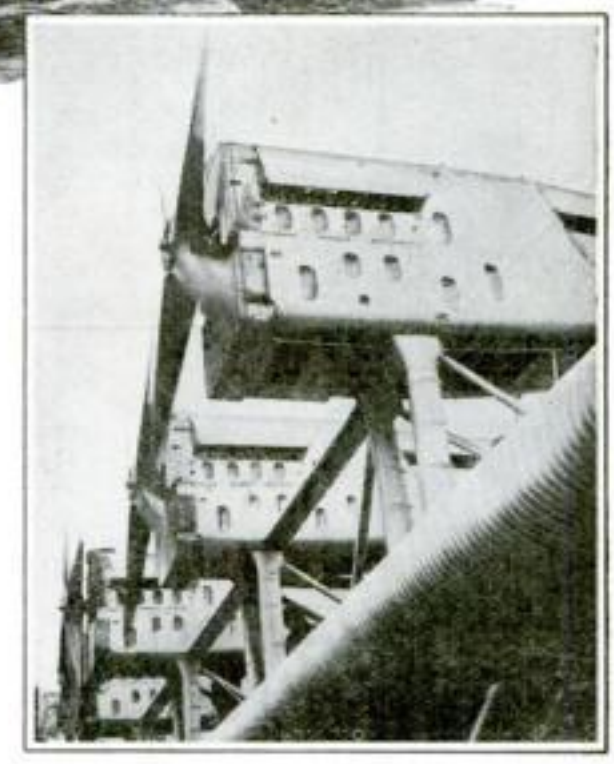
CAN DISPEL FOG BUT IT COSTS TOO MUCH

ON A SMALL scale, and in favorable circumstances, fog can be dispelled artificially. But all known methods are too costly for commercial use, the United States Department of Agriculture announces after a recent survey of experiments made to date.

Its review includes an electrical apparatus tried out on a house in Liverpool, England, a test with explosives in London, and the coating of a river at Lyons, France, with oil. The Cottrell process of electric precipitation, used elsewhere for smoke and dust control, was tested against fog on the California coast.

AMERICAN ENGINES PUT IN GIANT DORNIER *DO-X*

With twelve American motors, totaling 7,500 horsepower, the *DO-X* flies on Lake Constance.



ARE American makers of aviation motors keeping pace with progress abroad?

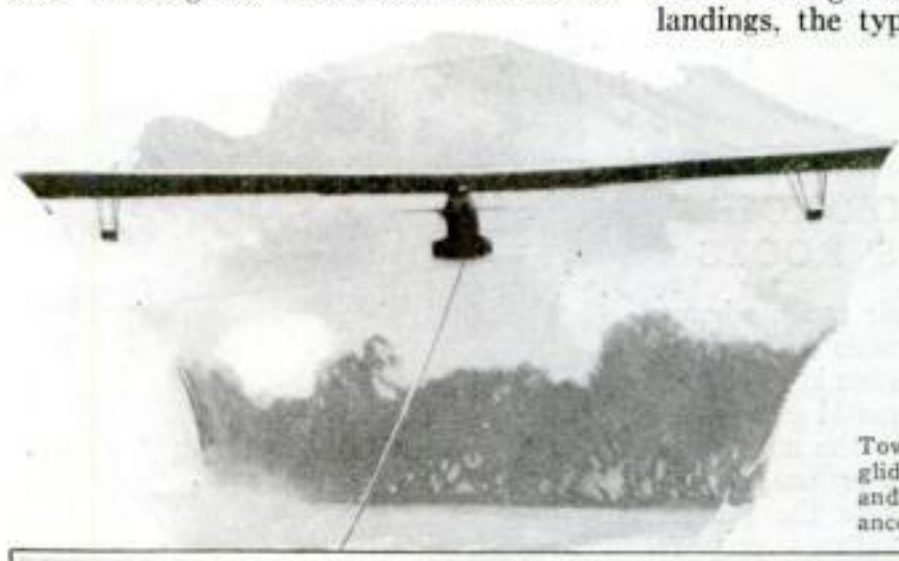
One of the best answers to that question was the recent substitution of American engines for German ones in the giant Dornier flying boat *DO-X*. The change was made at Altenrhein, on the Swiss side of Lake Constance, where the craft was made ready for its Atlantic flight.

Formerly the ship used twelve 500-horsepower motors of German design, mounted on a stub plane above the main wing. Both motors and stub plane were removed. Twelve water-cooled Curtiss Conqueror engines of 625 horsepower apiece were then mounted on struts along the upper surface of the main wing.

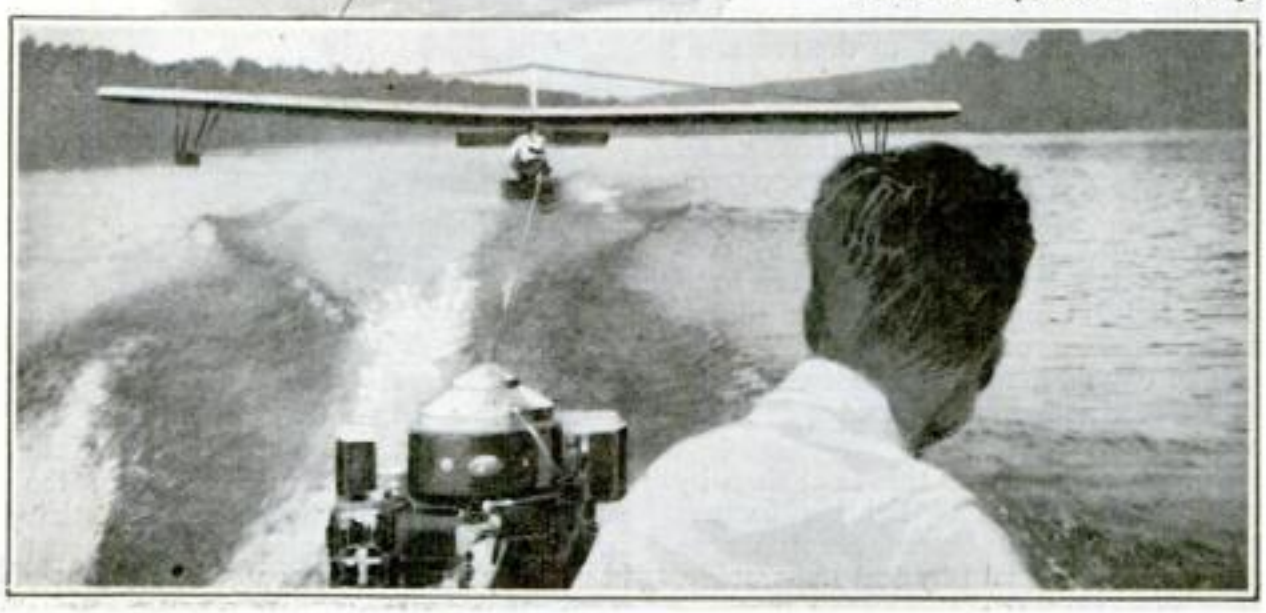
GLIDER LAUNCHED BY A MOTORBOAT

AN OUTBOARD motorboat successfully launched a glider the other day at Birmingham, Alabama. The test showed that gliding over water, in many ways safer for novices than land flying, is practicable wherever small boats are available for a tow. Since glider controls are similar to those of an airplane, glider flights over water may become a safe means of getting preliminary flight instruction.

The four-cylinder outboard runabout readily reached the speed of eighteen to twenty-five miles an hour necessary to launch the glider in still air. For water landings, the type of glider used carried one central pontoon and two on the wing tips. It is proposed at present to build hydro-gliders that will carry two passengers when towed by a motorboat. These water planes will have folding wings so they can be stored in ordinary boathouses.



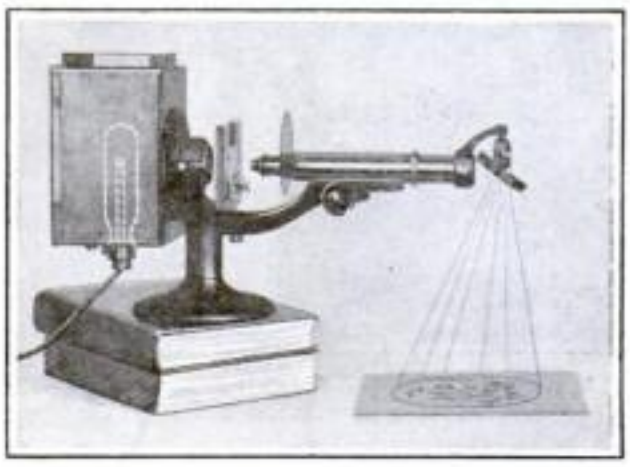
Towed by outboard motorboats, gliders are now being launched and students thus can learn balance and operation in safety.



PROJECTOR GIVES VIEW OF MICROSCOPIC OBJECTS

MAGNIFYING the microscopic world of nature and projecting it onto a screen is accomplished by a new instrument called a "micro-projector." It combines an ordinary microscope with a simple projection lantern. Any small object such as a bit of fly's wing, the body of an ant, or a group of live plant cells may be placed on the glass slide of the instrument.

The objects are projected by light from a lantern behind the slide onto a small mirror at the end of the microscope. This mirror in turn casts the image on a paper screen placed below it or at one side, depending on how the mirror is set. The image on the screen may be made from thirty to two hundred and fifty times the size of the object itself. The inventor claims that biology and other natural sciences may be taught much more vividly than before with the aid of this unique combination instrument.



A projection lantern is joined with a simple microscope to throw images of tiny things on screen, thus aiding in the teaching of biology.

ELECTRIC "INCUBATOR" AIDS PREMATURE BABY

AN ELECTRICALLY heated "incubator" is used in rearing prematurely born or very weak babies, in the Kaiserin Augusta Victoria Maternity Hospital, Berlin, Germany. It consists of a metal crib within a crib, the space between them heated either by an electric pad or a small electric heater. The main problem in keeping premature babies alive is to maintain the normal body temperature of 98.6 degrees F. To that end, the room temperature is kept at about eighty degrees and that in the crib from 100 to 110. At the head of the "incubator" is an oxygen tank to supply the crib. The babies are fed with a medicine dropper and bathed with oil.

NEW NOZZLE FOR HOSE WATERS PLANTS' ROOTS

WATERING plants at their roots, where the moisture is used, is made easy by a new attachment for the garden hose. This device, a short section of metal pipe with a pistol-like grip, clamps to the nozzle of the hose in a second. For use, it is thrust into the earth beside the plant. Pressure on a stopcock allows proper amount of water to flow to the roots.

"DAYLIGHT" FURNISHED BY IMITATION WINDOWS

IMITATION "windows," lighted by concealed electric lights, have been tried out successfully in England for office illumination. Bulbs are used that simulate the color of daylight, and the windows, placed on the walls, resemble real ones in shape and size.

Work is easier under this light than by conventional "indirect" lighting fixtures that use overhead bowls, according to tests of the National Physical Laboratory.

REVOLVING SANATORIUM ALWAYS FACES THE SUN

The patients in this French sanatorium face the sunshine all day, as the building revolves with the sun.

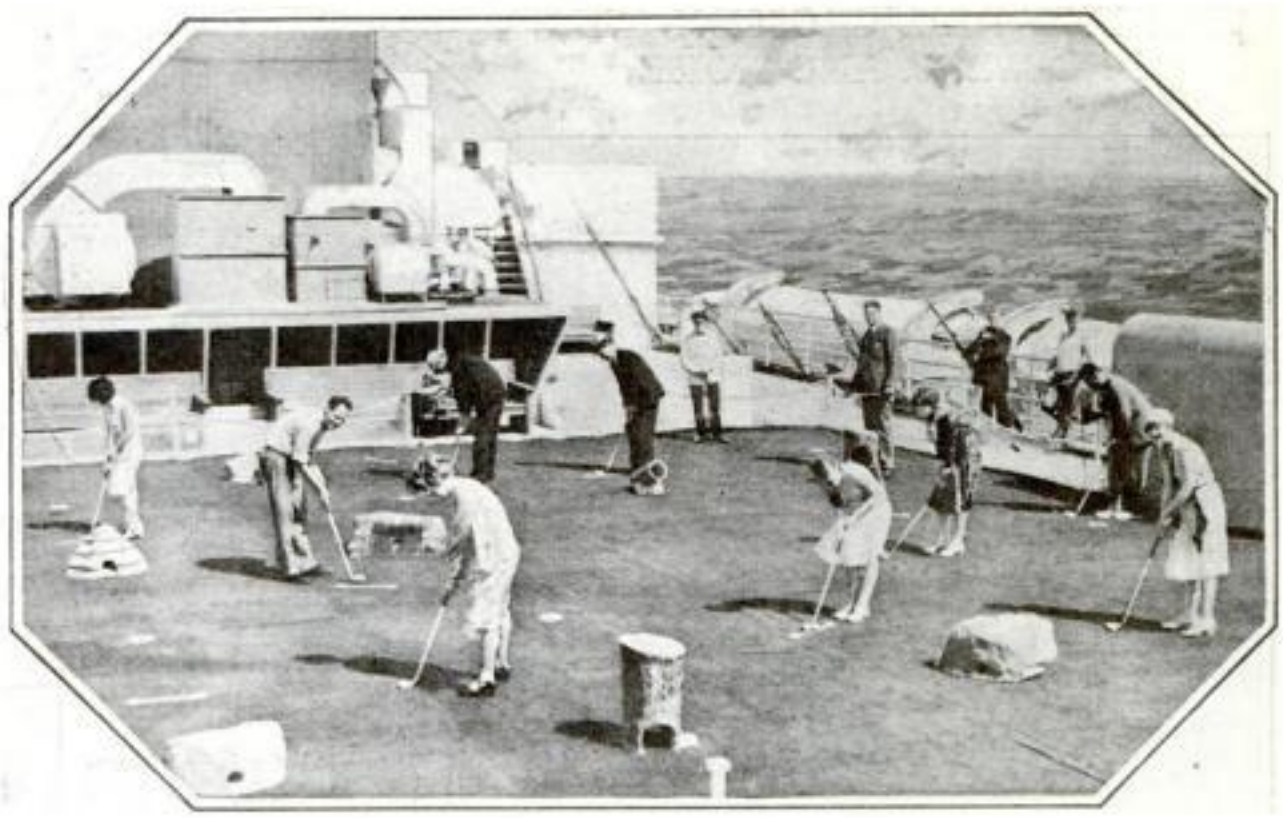
HERE is a house that follows the sun around. So that patients at a sanatorium in Aix-les-Bains, France, could face the sunshine all day, a novel solarium that revolves upon its conical base has just been completed. An elevator at the center of the tower affords access to the upper story. Because of its height, the solarium is always swept by fresh breezes, a vital part of the open-air and sunshine cure given the patients.

WHEN STROKE IS RIGHT, GOLF CLUB WHISTLES

A GOLF club that emits a loud whistle when the ball is hit true is the invention of Willie Dunn, of Clayton, Mo. The club, a driver with steel shaft, has a large hole in the bottom of its head, which is provided with a hollow sound chamber inside. When the club is swung at the correct angle and with the proper speed, the air entering the hole produces a clear whistle.

Thus the golfer carries his own applauding "gallery." Dunn, who is known around the world as "the grand old man of golf," is said to have played golf at the age of three, sixty-three years ago, in Scotland. He was America's first open golf champion, and laid out the first golf course on Long Island, N. Y. His new club, he says, will prove helpful to experienced players whose drives have temporarily gone wrong, letting them check their swing.

Willie Dunn, grand old man of golf, with his new club that whistles when stroke is right.



TOM THUMB GOLF GOES TO SEA ON BIG LINER

SHUFFLEBOARD as a pastime for passengers on ocean liners is being crowded out by Tom Thumb golf which, after sweeping the country (see page twenty-two), now has hit the high seas. A miniature nine-hole course, measuring forty by fifty feet, was installed recently on the sun deck of the *Ile de France*.

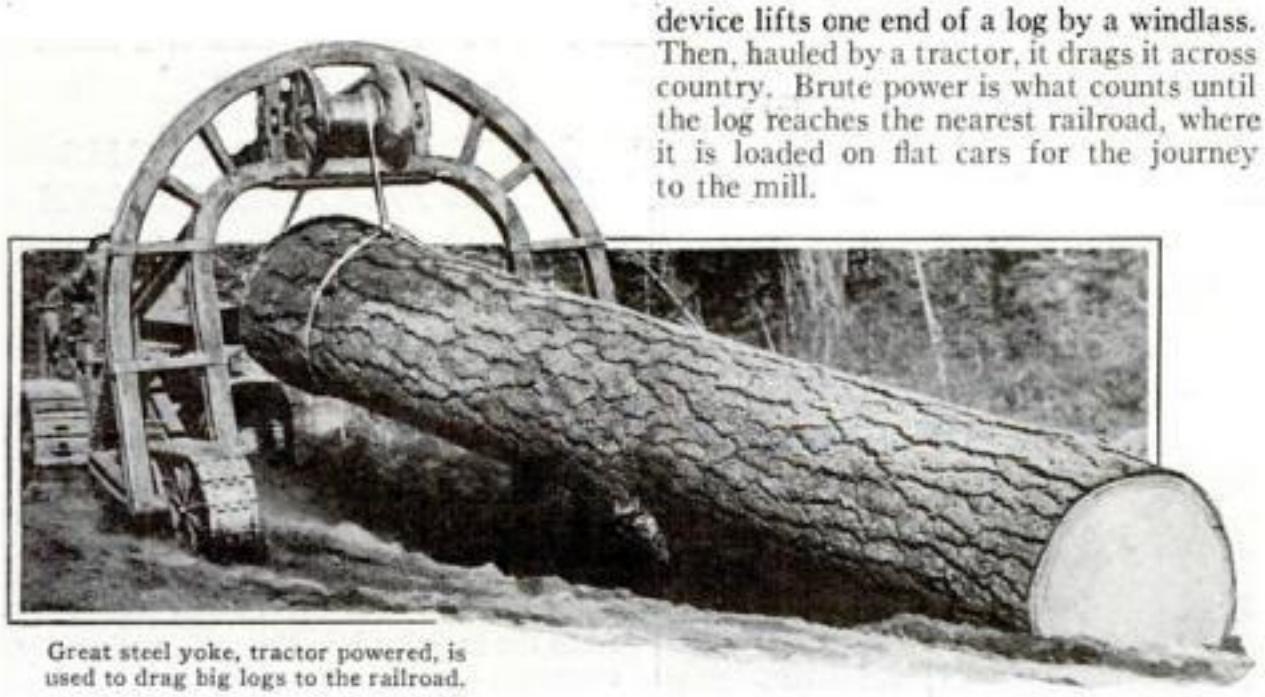
The "grass" of the course consists of cottonseed hulls, matted together and stained green. For that reason, the putter, the head of which is flat, is the only golf club used; the mashie, because of its loft, would tear up the fabric. Small elevated tunnels of various shapes through which the ball must be driven, tree stumps, rocks and sand serve as hazards. The movement of the ship, in ordinary weather, adds another natural hazard, but does not seriously interfere with the game.

STEEL YOKE DRAGS MIGHTY LOGS

A HUGE steel arch, shaped like an upside-down "U" and mounted on caterpillar wheels, aids in the Herculean task of dragging big logs out of the forests of the northwestern part of the United States to be made into paper pulp.

The illustration shows how this modern device lifts one end of a log by a windlass. Then, hauled by a tractor, it drags it across country. Brute power is what counts until the log reaches the nearest railroad, where it is loaded on flat cars for the journey to the mill.

This tractor-drawn yoke takes the place of the big horses with the numerous crews of men formerly used in getting the logs to the railroad or the nearest stream down which they were floated. Fewer men and faster movement of the logs are said to be possible with the new machine.



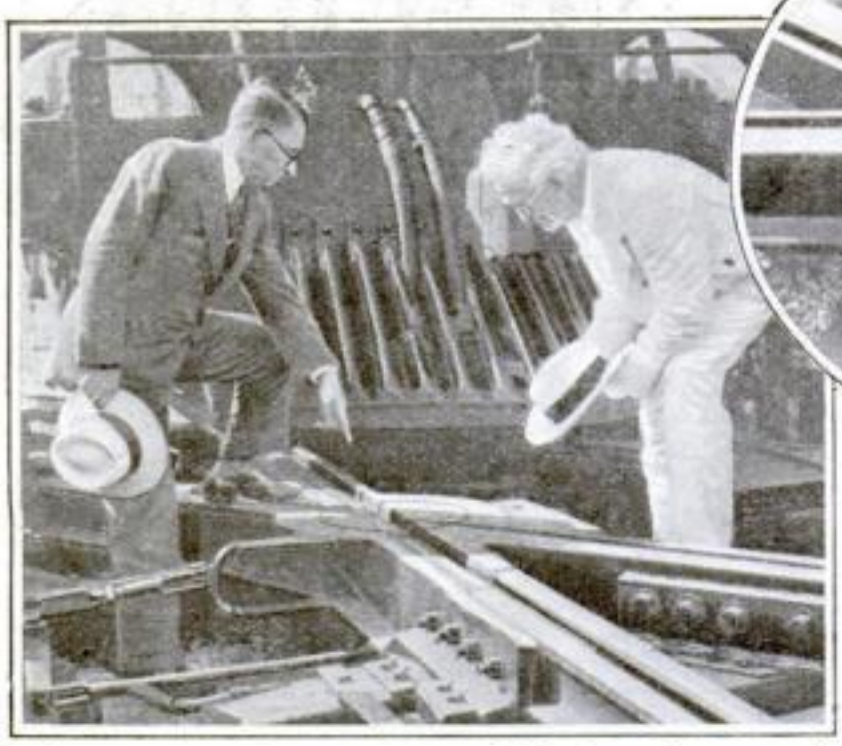
Great steel yoke, tractor powered, is used to drag big logs to the railroad.

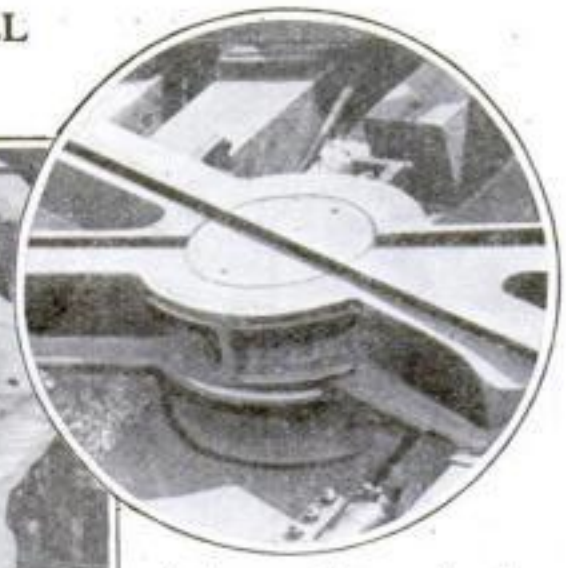
RADIO WAVES EXPECTED TO KILL FRUIT PEST

WILL high-frequency radio waves kill obnoxious insect pests in orchards and fields? Henry Fleur, of San Jose, Calif., says they will, and has just built a curious "death ray" machine with which he proposes to wipe out unwelcome bugs. The high-frequency currents, generated in a small portable instrument, are carried by wire to a vacuum tube device mounted on a tripod for application.

While Fleur's machine may or may not succeed, there is no doubt that radio waves will kill insects in the laboratory. Experts of the New Jersey Agricultural Experiment Station, under Dr. Thomas J. Headlee, not long ago succeed in killing flies and cockroaches placed in glass tubes by exposing them near a high-frequency radio transmitter (P. S. M., Feb. '30, p. 145).

THIS NEW RAIL CROSSING WILL END WEAR AND NOISE





A close-up of the new "continuous rail" crossing. The center disk turns automatically to align itself with an approaching train.

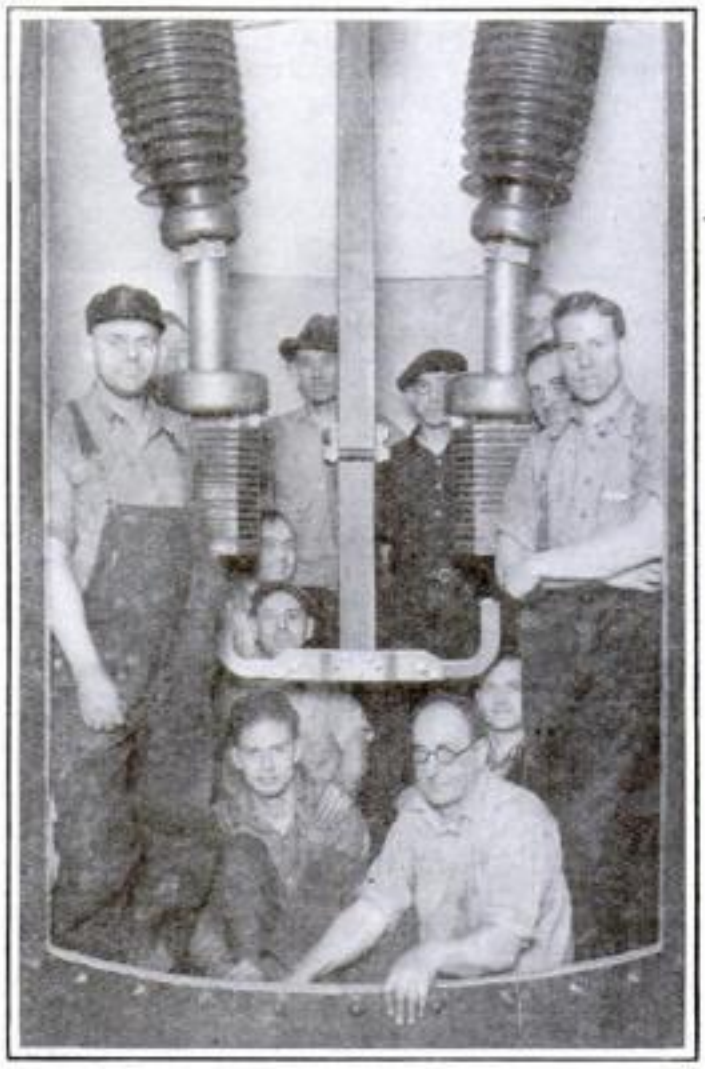
The Whalen noiseless crossing, installed in a piece of track near Los Angeles, Calif., gets its first test.

SIX months of secret tests ended the other day with a public demonstration of a "noiseless" crossing rail at Los Angeles. Designed to make America's 400,000 railway crossings jar-proof, it was the invention of W. H. Whalen, former general superintendent of the Southern Pacific Railroad. At the X-shaped spot where rail grooves ordinarily allow a wheel to thump into a depression, Whalen's invention substitutes a device that provides a "continuous rail." This contrivance, a close-fitting grooved disk, turns automatically to align itself with an approaching train. It gives wheels passing over it continuous support and thus eliminates both the noise and the hammering that wears out the rails. The result is declared a boon to railroad maintenance men and to people who live near a railroad crossing.

HUGE CIRCUIT BREAKER CAN HOLD A DOZEN MEN

TWELVE men in a circuit breaker recently demonstrated the enormous size to which engineers can now build this type of electric equipment. The machine was designed by the Westinghouse Electric and Manufacturing Company to break high voltage circuits automatically and shut off electricity in a fraction of a second, saving transmission lines from lightning or overload damage.

In use, the chamber, which the men occupied, is filled with oil, which does not conduct electricity. Magnetic controls, a recent innovation, force the sparking arc into close contact with the oil when the circuit is broken, making the shut-off of current practically instantaneous.



This circuit breaker, big enough to hold twelve men, shuts off the current in a fraction of a second.

GIANT AWNING SHADES 20 STORES

SHADING twenty stores, a "community awning," probably the world's largest, proved a boon to Sixty-ninth street, Delaware County, near Philadelphia, Pa., during the protracted hot spell last summer. The giant sunshade measured 200 by eighty feet. To make it, 3,200 yards of cotton bunting, 4,000 yards of nonstretch web, 5,000 feet of three-eighths-inch wire cable, 4,500 feet of three-eighths-inch manila rope, more than a ton of angle iron, and a great deal of skill were required. Still, it took only ten days to complete the job.

White with blue borders, and with the street number, "69," appearing twice in vivid green, the huge awning gave the block the gay appearance of a banner-decked Japanese thoroughfare. As its material was not rainproof, the great sunshade, built in eighteen sections, was pulled back every night and taken in whenever a storm threatened.

BURNING BLUFF IS BIG MYSTERY

SMOKE from a rocky bluff near Burke, S. D., mystifies visitors. The ground is hot to the touch, and coyotes and other animals go there to warm themselves. At the bottom of a freshly dug hole, the ground is too hot for the hand to bear it.

Two hundred feet long and eighty feet wide, this gigantic awning, probably the largest in the world, was made in Delaware County, Pa., to keep the sun off twenty stores.

LACK OF COLD GERMS MAKES ISLANDERS MOVE

WITHIN a short time the few dozen persons remaining on Saint Kilda Island, off the coast of Scotland, will abandon that mysterious island forever. Their departure will end one of the strangest stories of medical science.

Completely isolated by gales from the Scottish coast during eight or nine months of the year, the 200 former inhabitants of this two-by-three-mile island lived in exceptionally good health. But immediately with the landing of the first boat from the mainland, in the spring, virtually everyone caught cold.

The epidemics remained a mystery until doctors discovered that during the winter isolation most of the "cold" germs died and the islanders lost their natural immunity. When the first mainlander stepped ashore with his germs from the outside world, the whole community caught the malady. Hence they are removing to the mainland where colds are common.

LETTER BOX RAISES LID AS POSTMAN DRIVES UP

A HINGED lever on a new automatic letter box makes life easier for the rural mail carrier. When he drives up to the box, a rod on the running board of his car engages the lever. The lid rises, and the carrier can deposit mail in the box with one hand and without leaving his seat.

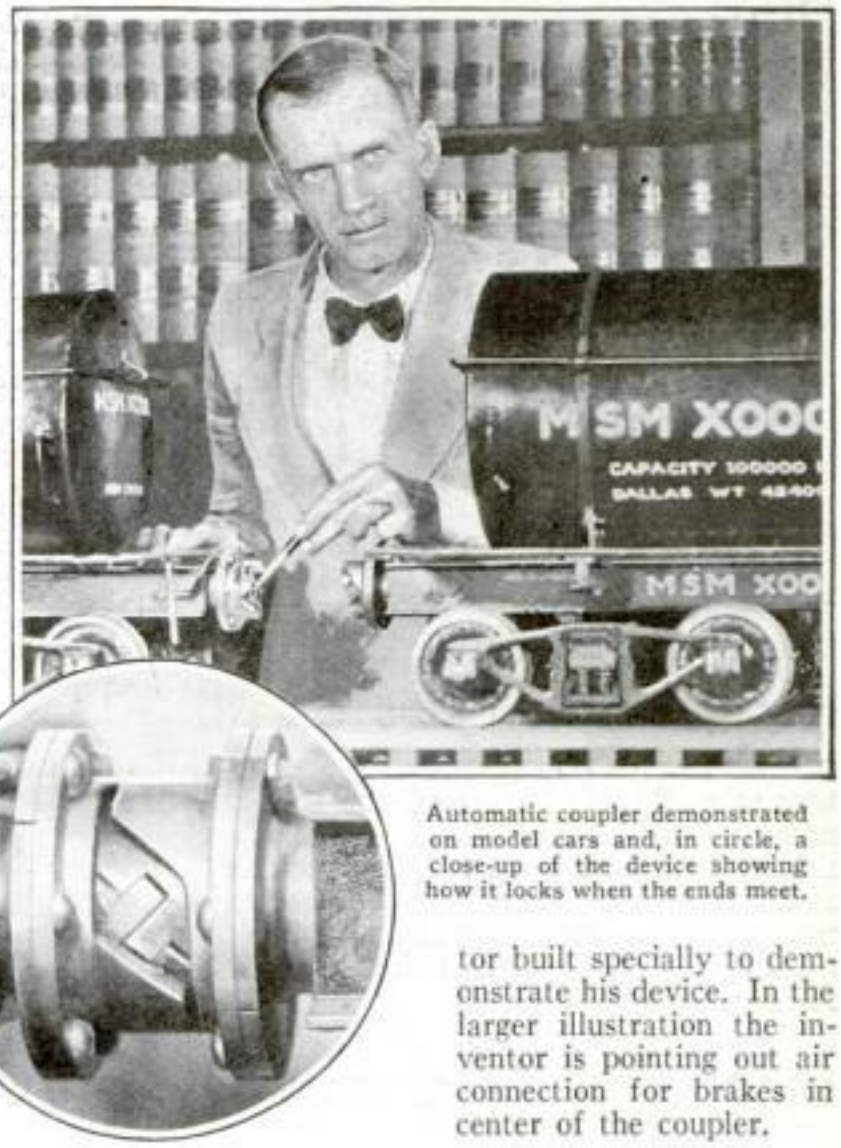
As he drives on, the lid automatically drops back into place and a red flag appears to notify the resident that mail awaits him inside the box.

CAR COUPLER CUTS RAILROAD HAZARD

THERE are no knuckles to be preset, nor air hoses for trainmen to connect, in a new safety coupler for railroad cars. According to its inventor, a Texas railroad man, it eliminates thirteen hazardous operations in connecting cars.

So fully automatic is the new coupler, cylindrical in shape, that cars may be joined as rapidly as a locomotive can push them together. A trainman's presence is not required at the coupling point. The air connection is made through the center of the coupling, instead of through a separate hanging pipe.

Because of four lugs, each larger than the shank of the standard coupler, it is said that the device can pull eight to ten times the usual load. The photographs at right show a pair of the new safety couplers mounted on two lifelike model tank cars which the inventor built specially to demonstrate his device. In the larger illustration the inventor is pointing out air connection for brakes in center of the coupler.



Automatic coupler demonstrated on model cars and, in circle, a close-up of the device showing how it locks when the ends meet.

BUILDS OUTBOARD FROM POPULAR SCIENCE PLANS

ABOVE is Paul Goldieri, sixteen-year-old amateur shipwright, of Brooklyn, N. Y., seated on the framework of a motorboat he is building in his back yard from POPULAR SCIENCE MONTHLY plans.

Paul saw and liked the plans and complete working directions for building a fifteen and one half-foot family outboard published in POPULAR SCIENCE MONTHLY in March and April, 1930. He set to work almost at once, and now the graceful craft is fast taking shape under his hands. The finished boat will be a steady, flat-bottom craft suitable for family outings and camping trips.

TWO FERRYBOATS MADE GIGANTIC WET BATTERY

Two metal-hulled ferryboats of San Diego, Calif., once berthed at the same pier, are now kept separate at opposite sides of the bay. They had been discovered to form a gigantic electric battery whose current was eating their hulls away.

Formerly the copper-sheathed boat *Ramona* was tied alongside the steel-hulled *Coronado*. The proximity of the two metals, plus the salt water of the bay, made a combination much like an old-style wet battery. An electric current flowed between them, and although the amount was slight it was decided that the only way corrosion of the hulls could be prevented with certainty was to keep the two boats away from each other.

NEW LAMP HAS THREE SHAPES

Now anyone can build his own bridge lamp. If he tires of its shape, it readily takes on a brand-new form.

A set of parts for building the changeable lamp has just been placed on the market. The fittings may be assembled entirely by hand, without need of screw driver, pliers, or other tools. They fit together to make a standard bridge lamp, an indirect bridge lamp, or a table lamp.

The new idea in lamp-making is made possible by substituting insulated metal shafts for wires in the lamp columns. Therefore there are no wires to reconnect when the design is changed. Only the base is wired. The shafts conduct the current to the bulbs.

Above, the changeable lamp built as an indirect bridge light and, at left, the same lamp quickly transformed, without tools, into a light for the table.

FLASHLIGHT FOR DIAL TELEPHONE CLIPS ON

DARK corners do not inconvenience the user of a dial telephone equipped with a new lamp-and-glass attachment. A small flashlight throws a beam of light upon the face of the dial, while a magnifying glass makes the characters easy to read. Both are a part of a clip that fastens in a moment to the telephone.

COLORED AUTO TIRES TO MATCH CAR'S PAINT

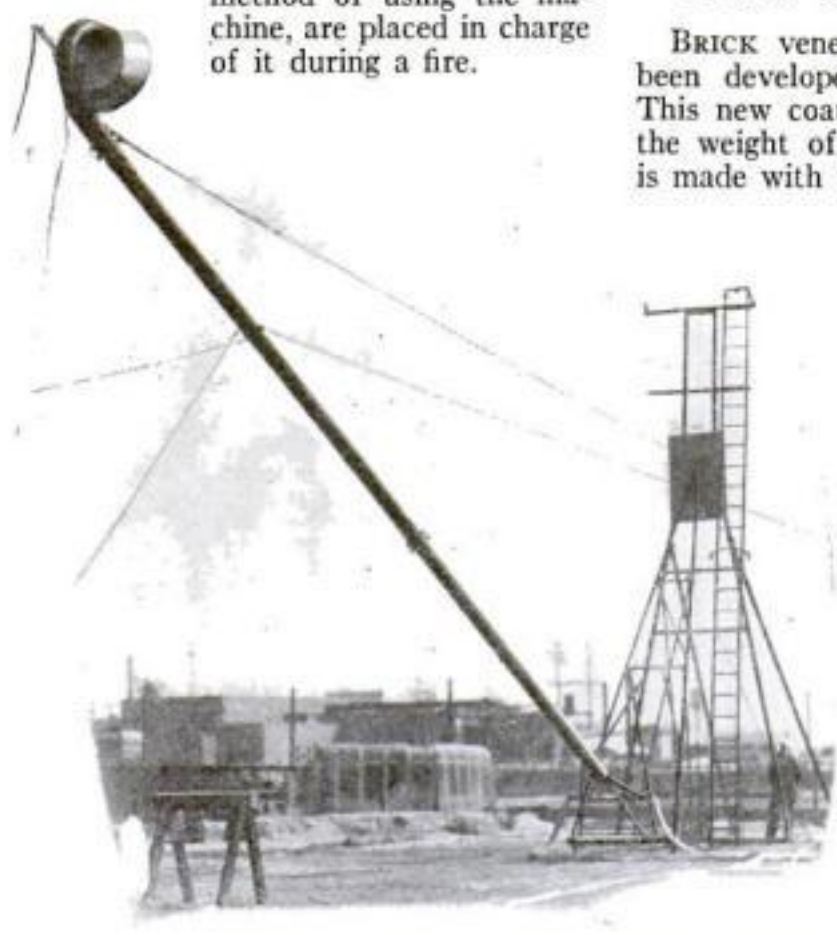
COLORED automobile tires, whose hues match the car's finish, are announced by a Detroit, Mich., maker. They are the result of long research to find a way of imparting a color that will last.

Automobile tires present unusual problems because of the moisture, mud, and extremes of heat and cold. The new process uses paint ground so finely that the particles are almost of atomic size. This paint impregnates the rubber latex and a protective coating is given later.

GOOSENECK TOWER USED TO FIGHT OIL FIRES

MEET the first cousin to the water tower—the "gooseneck" tower, a new invention to fight fires in oil tanks. Recently adopted by California oil companies, it shoots a spray of foam that blankets the flames and smothers them.

When fire starts in an oil tank, the gooseneck tower is backed up to the base. Then men draw up the nozzle, by means of cables, until it projects over the rim of the tank. When the valves are turned, a torrent of foam pours down and covers the surface of the blazing oil. Workmen, drilled in the correct method of using the machine, are placed in charge of it during a fire.



Oil tank fires are now fought with this gooseneck tower which raises a nozzle to top of tank and smothers flames with foam.

A new brick veneer is made in units of twelve bricks and is one inch thick.

NEW BRICK VENEER IS ONLY ONE INCH THICK

BRICK veneer only an inch thick has been developed by a Detroit engineer. This new coating for houses is one fifth the weight of ordinary brick veneer. It is made with twelve bricks to a unit, the bricks themselves being one half inch thick, cemented to insulating board of the same thickness. These units, attached to the outer wall, transform the house into a brick structure.

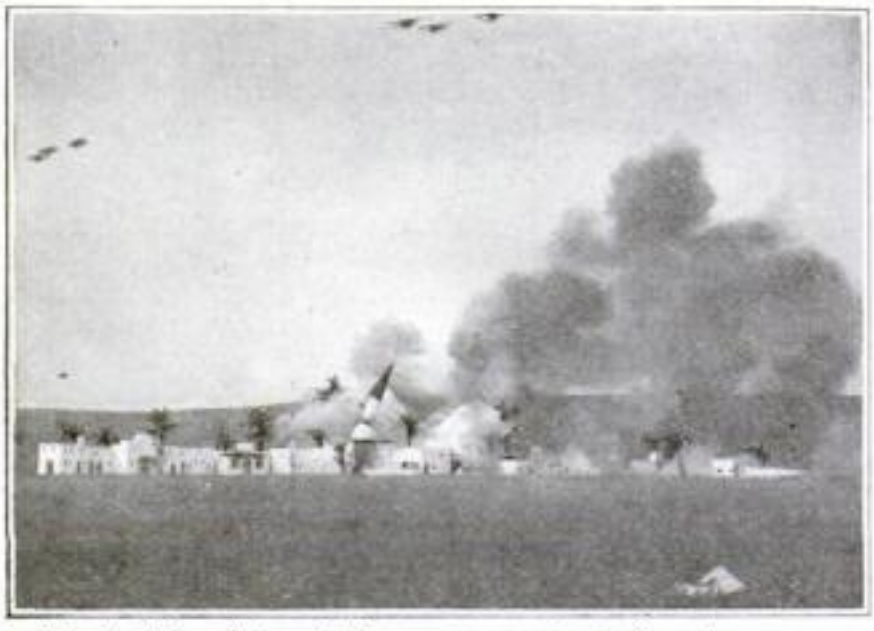
BOARD RACK REVERSIBLE

A REVERSIBLE rack, holding a slated cloth on rollers, is the invention of a Daytona Beach, Fla., man. Swinging the rack around brings the other side of the blackboard into use. The new device is portable.

PLANES BOMB MINIATURE VILLAGE

AN ELABORATE reproduction of an Arabian village, built in miniature, furnished spectacular target practice for airplanes in a recent Italian aviation meet. The airplanes, flying low, raked the tiny village with aerial bombs. A photographer snapped the destructive result just as the highest spire toppled, while flames leaped up to destroy the rest of the town.

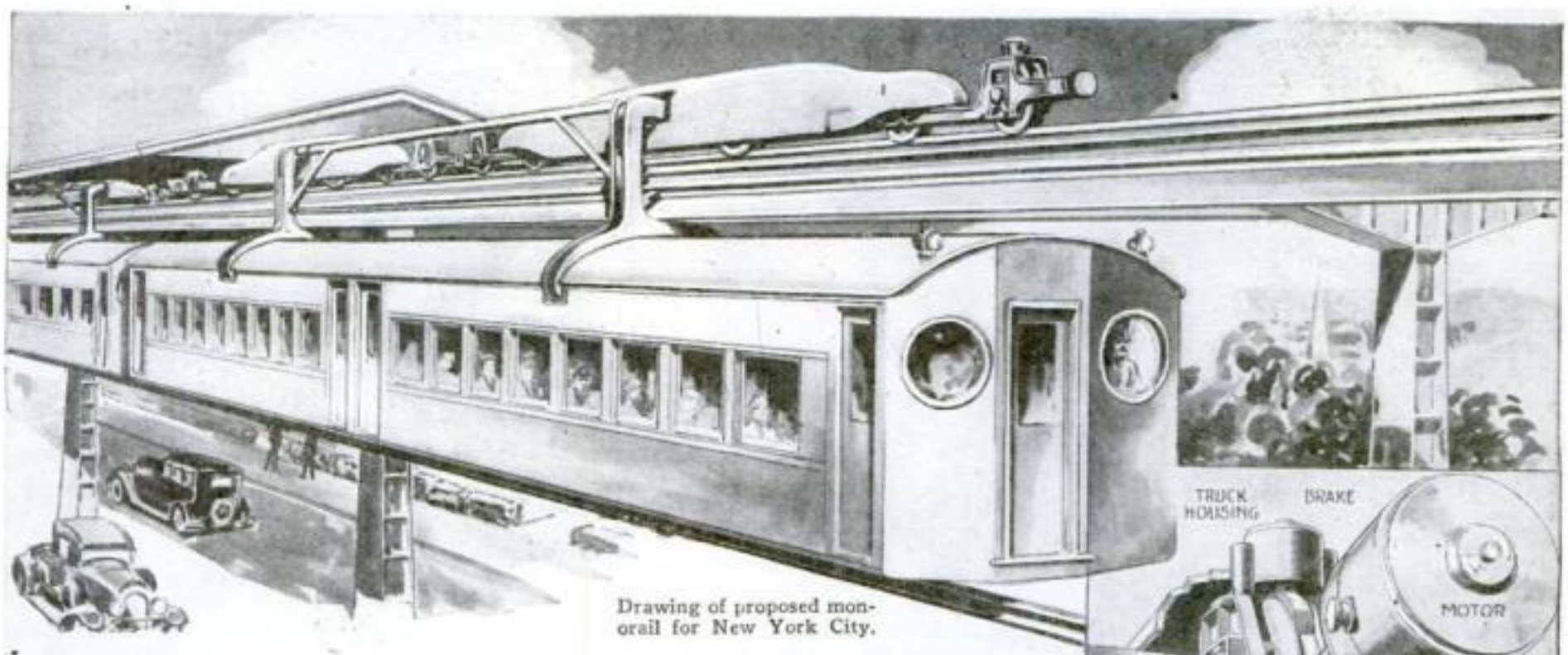
Big bombers and little scout planes were used in this attack on the doomed town and the maneuvers were carried out in strict accordance with the latest Italian military development. The complete success of the attack, and the speed with which the village was destroyed, are indications of effective offensive operation of the present airplane in waging war. The direct hits were scored with such ease that it is evident the bombers of today must be vastly superior to those used during the World War.



This Arabian village, built as a target for Italian airmen, was destroyed by bombers. Photo shows direct hit of tallest spire.

Blackboards or maps, hung in this rack, can be instantly reversed by swinging the rack right or left.

America's First Monorail Line Planned for New York



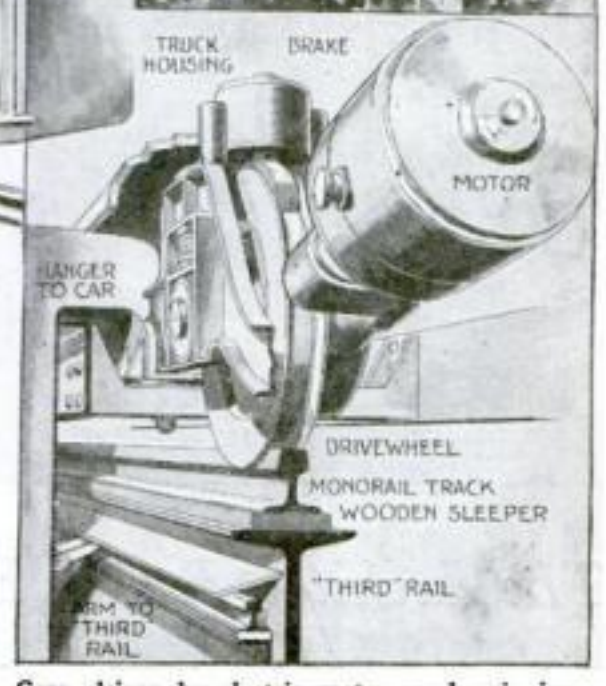
Drawing of proposed monorail for New York City.

NEW YORK may get the first suspended monorail line in America. Officials are considering an eastern concern's proposal to build an overhead, rapid transit railroad that would have but one or two counterparts anywhere in the world.

Cars suspended in mid-air would run at forty-five miles an hour over the tops of automobiles and street cars. They would be hung on grooved wheels from a single overhead rail. The system of T-shaped towers and welded framework necessary for such a line would not obstruct street traffic and sunlight as much as the conventional elevated railroad structure, its advocates point out.

While details of the system are being kept secret, POPULAR SCIENCE MONTHLY obtained permission from Frank S. Lyon, president of the firm which is developing the monorail, to examine the blueprints on which the accompanying drawings are based, and to present a description of the system.

Cars will be made of duralumin, a light airship alloy. They will hang on trucks from a single rail similar to that of an ordinary railroad track. Four fifty-horsepower electric motors mounted in the trucks will drive each car. Electricity is obtained from a rail mounted on the side of the I-beam supporting structure. To make the cars as nearly noiseless as possible, a housing incloses the wheels, the rails are laid upon sound-absorbing sleepers of wood, and the steel wheels are of a recently developed "noiseless" type.



Cars, driven by electric motors and swinging from a single rail, will travel at 45 miles an hour.

WOOD FINISH FOR WALL NOW COMES IN ROLLS

Now real wooden walls, for home or office, come in rolls.

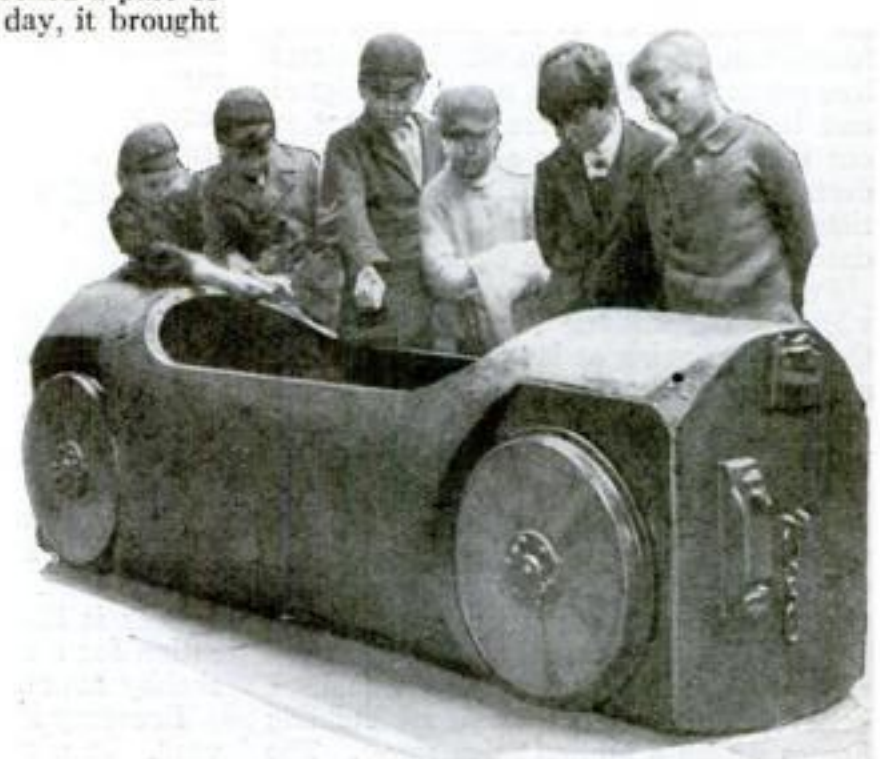
A new wall covering is as flexible as wall paper, and as easy to apply, yet it is made of wood. Laid in strips on a wall, it gives the appearance of wooden panels. Oak, mahogany, walnut, or maple may be applied to the wall in all the beauty of its original grain. The product is made by treating thin slices of wood to make them pliable and fastening them to an adhesive backing of stout cloth.

GAS BLAST UNCOVERS ODD LONDON RELIC

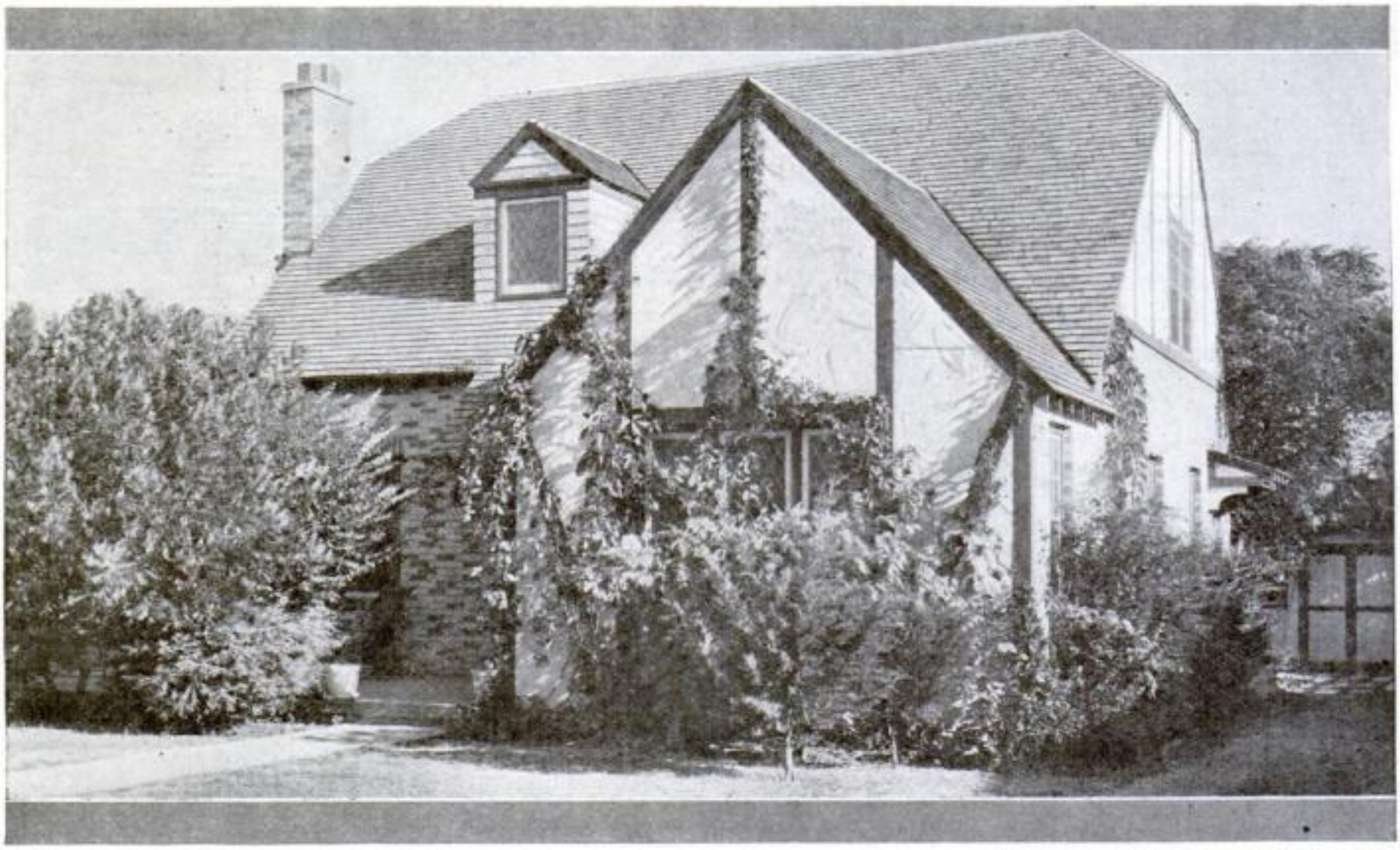
WHEN a gas explosion rocked a part of London's streets the other day, it brought to light a curious relic of the past in the shape of a heavy iron vehicle on close-fitting wheels.

Few recognized it for what it was—a vehicle designed by an early inventor in an attempt to speed the London mails through huge pneumatic tubes, among the largest ever built and far larger than any in use today. In 1864 such a tube, four feet high and four and a half feet wide, was laid between the General Post Office and the Euston Station. A fan twenty-two feet in diameter exhausted air from one end of the tube and pumped it in at the other, to propel the wheeled carriages and their load of letters and packages along tracks. However, the speed of seventeen miles an hour attained by these carriers proved too slow to transmit mail in bulk, and it was abandoned, forgotten until the chance explosion brought it to light.

Today wheelless, torpedolike mail carriers whiz through pneumatic tubes of only eight-inch diameter, which have been found more practical in New York and other cities.



Nearly a hundred years ago, this strange vehicle, loaded with mail, was driven by air through a big tube under London's streets.



Built for comfort, beauty, and roominess, this Dallas, Texas, home gives the impression of being much larger than it is, while the garden effect adds to depth of the lawn.

The Architect Builds His Own Home—A Series

Avoid Fads, Plan for the Future

Dallas Builder Stresses Simplicity as a Sound Investment and Good Art

By
HARRE M. BERNET

When he plans his own home an architect has, for once in his life, a free hand. Naturally he puts into this effort everything that seems to him best and most desirable. Hence these articles by men who have built their own homes are the most novel and helpful contributions to home building ever yet published.

—THE EDITOR

IT DOES not necessarily follow that the house an architect builds for himself will be architecturally supreme; no more so than that all mechanics have smooth-running cars, or that doctors are never ill. Indeed, I have found that the houses in which architects live are more often than not, not designed and built by themselves at all—bearing out the adage that the shoemaker's children often go barefooted. The architect's time and creative energy are consumed in designing houses for his clients.

One of the rarest pleasures, however, which an architect may have comes through designing at least once in his life a house entirely to please himself. One's clients often have most decided ideas which, sadly enough, do not always coincide with the architect's. Thus, an architect does have a chance to incorporate into the home he builds for himself many features that add to the beauty, and often to the economy, in this particular job.

I have, in the house that I built for my family, some features that would, I believe, appeal to many who are building homes within a limited price range. The outstanding characteristics are:

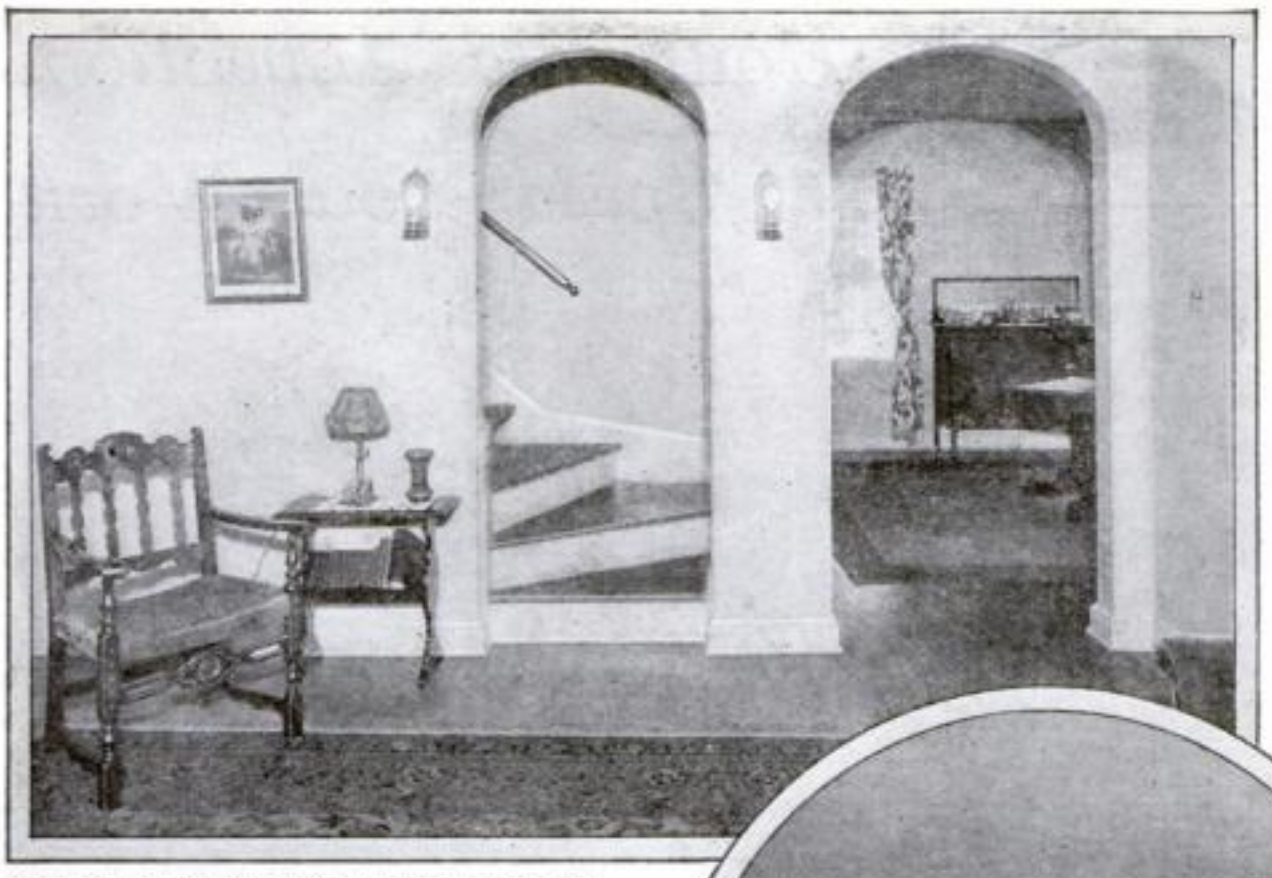
More roominess than would be suspected from the exterior. This, on a moderately sized lot, is imperative. An overlarge house appearing to absorb the lot on which it is built is an eyesore and a blot on any street; and, further, precludes all possibility of landscaping the ground with any degree of success.

Beauty of architecture and soundness of construction. Without the latter, the former is likely to prove small compensation for a ramshackle, crumbling, soon-shabby house.

Economy in arrangement and materials used. In a small house, there are nooks and corners which, if wasted, render the house stuffy and insufficient to one's needs; but which, if used to good advantage, as they may be, not only increase the efficiency of arrangement but skillfully lend unusual notes of beauty. On the subject of economy of material, nothing need be said other than that the economy, naturally, should not be so extreme that the soundness of construction is imperiled.

Those factors, to which the home builder should look, be he architect or layman, were my bases. The house, exclusive of the site, was built at a cost of about $12,500. After living in the house, which is the supreme test, neither Mrs. Bernet nor myself would change any major arrangement or effect, although we probably would make a few alterations in detail—this being the quite logical result of the human desire for variety.

In Texas, as elsewhere, of course, the foundation for any construction is of major importance. Nevertheless, a problem exists in this part of the country that it not prevalent in the North, where I built houses for a number of years. We have a black, waxy mud in Texas which has an inconvenient, restless habit of moving about; almost imperceptibly, it is true, but the ground on which a house is built does not have to move all over the lot to



An inclosed stairway, a bit of which is seen above, is an attractive feature of the Bernet residence.

render difficult the architect's problem.

In addition to this quaint habit of the Texas soil, there is a river whose tributaries flow beneath the earth's surface in many places. Should you happen to build a house above one of them without preparing for such a contingency in your foundation, you may find your house cracking. Thus, in Texas, we use the "beam and pile" system.

My house is, in reality, built upon invisible stilts; that is, in my foundation, I have a twelve-by-twenty-four-inch reënforced concrete beam around the outer rim with ten-inch piles approximately eight feet on the center, the reënforcing reaching to the full depth of the pile and up into the beam. This guards against the building's cracking. At the rear, the house is four feet off the ground.

For the outside materials, we used brick veneer on wood. In this climate, this type of construction has proved itself preëminently satisfactory and is, in addition, less expensive in the long run. The exterior walls are a light, ivory brick, spotted irregularly with dark brown or chocolate, with brown English half timbers and light ivory stucco, rough with long, deep, curved scratches in the gable ends.

Bernet's Colonial style mantel, with marble facings and flanked by double windows, is a distinctive note in lounge.

The shingled dormers, front and rear, have leaded glass casement windows which swing out by operation of lever handles on the inside, and which show spots of color, the lead divisions being uneven by means of some of the glass panels having been broken and then leaded at the breaks. These windows are screened on the inside to permit the casements to swing outward.

The roof is covered with standard predipped brown shingles. The paint trim for the sashes, frames, and screens is light ivory. The ivory and brown color scheme harmonizes well with whatever landscaping one does, wears well, and, no matter what the weather conditions, merely softens in tone rather than becoming overly weather beaten in appearance.

Touching off the top is a chimney cap of stone with two clay chimney pots of different heights, the chimney tapering from five feet at the grade to three at the top.

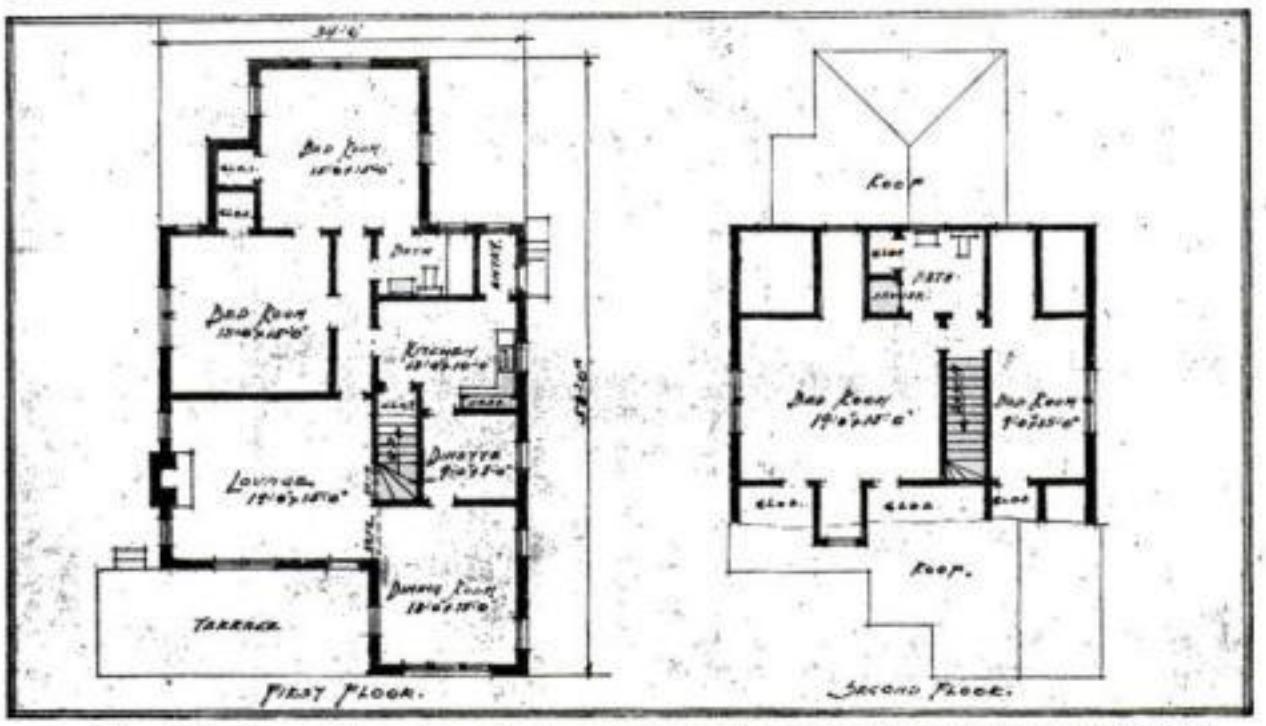
The gable ends, both east and west, are half timbered with stucco from the second floor window sills up. The projection on the rear, off the lower floor back bedroom, contains two closets. Such breaks, or offsets, combine to make the rear elevation less monotonous than is usually the case. The long, wide dormer on the rear has three casement windows with divided sash that ventilate the two second floor bedrooms and the upstairs bath.

The kitchen entrance has a cover supported on brackets with a two-foot concrete platform to be used as a motor entrance in the rear, enabling one to step direct from the automobile to the platform. The gravel drive is on the west side and has been planted with grass which more than half obscures it, the gravel only faintly indicating where the motor tracks are. It is my belief that the regulation concrete driveway is a mistake on a small lot—mine is fifty-five by one hundred and fifty feet—cutting off, as it does, almost eight feet of land and narrowing the side on which it is placed.

The front walk to the house is curved —not a new idea, but one which lends grace and suggests greater depth to the land.

The dining room facing north was made to project beyond the main front line, as was the bedroom in the rear. The front porch was left without a roof. Originally, the porch did not project beyond the east wall, but on a visit to the house while it was in the process of building, I noticed a wonderful breeze coming from the east and accordingly extended the porch six feet to capitalize this asset. In this southern country, we give ventilation and exposure a good deal of careful study. For example, it is essential that every room have ventilation, if possible, from all four sides, either by windows or doors.

The ground on which the house is built slopes gently *(Continued on page 156)*



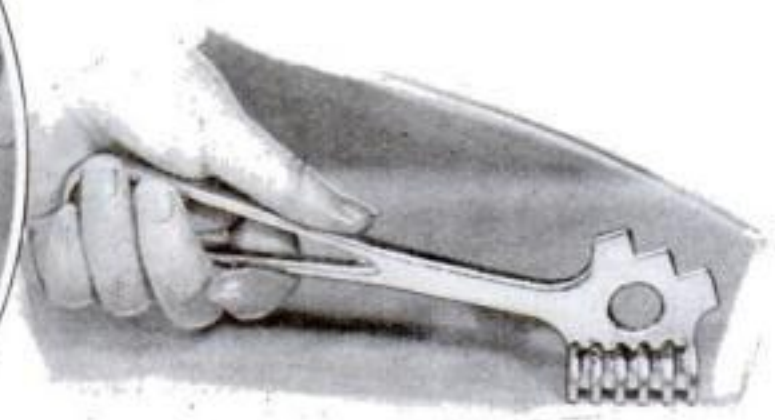
A study of the Bernet plans, shown above, will give a clear idea of the spaciousness of this small house which was designed to secure the most, in looks and value, for the $12,500 invested in it.

Household Inventions to Speed Your Work

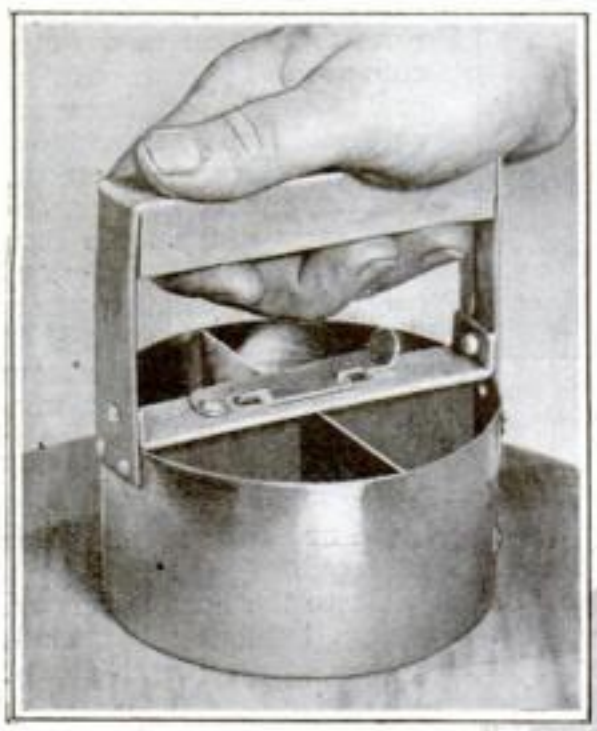
KITCHEN IN A CABINET. Occupying four feet of space, this steel case is a unit kitchen, containing a four-burner gas range with oven, sink and drainboard, refrigerator, china closet, ventilator, and drawers. It is especially designed for use in cabin or cottage.

NO TEA LEAVES IN CUP. These little tabs permit you to make your tea directly in the cups without tea leaves, which makes the washing of the cups a simple matter. The tabs, which look like lumps of loaf sugar, dissolve at once when boiling water is poured over them.

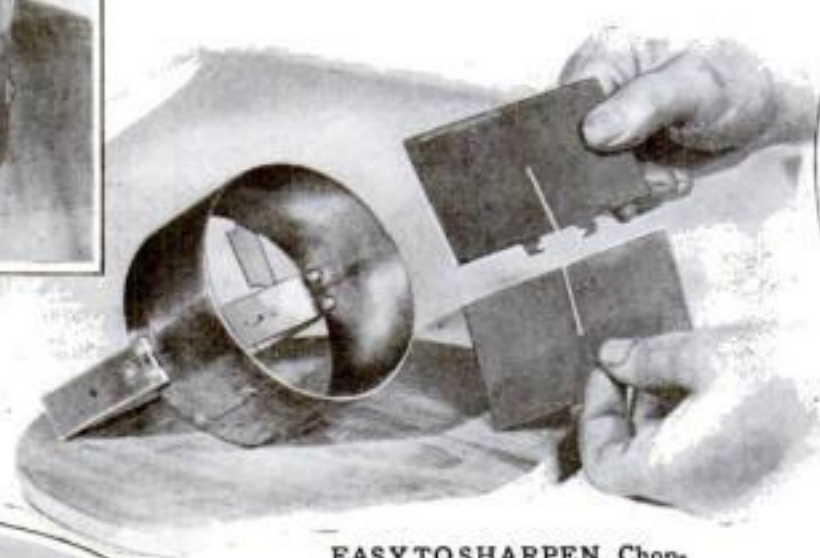
CAN OR JAR OPENER. Here's a tool that serves as a jar opener when it is fitted around top as shown and tightened by twisting handle or as can opener when inverted and blade pressed down.



ICE PICK IS NOT NEEDED. By using this pronged tool the hazards incident to the use of a sharp ice pick are done away with. It chops ice easily and the pieces can be pounded as fine as desired. It also can be used to make meat tender by breaking up the tough fibers.



CHOPPER SAVES JUICE. Built to chop almost anything, this new household utensil can be used on board or in bowl and will reduce meat to a pulp, nuts to a fine dust, and vegetables to any size you want.



EASY TO SHARPEN. Chopper shown at left above is taken apart by sliding one clip which frees blades so that they can be removed.

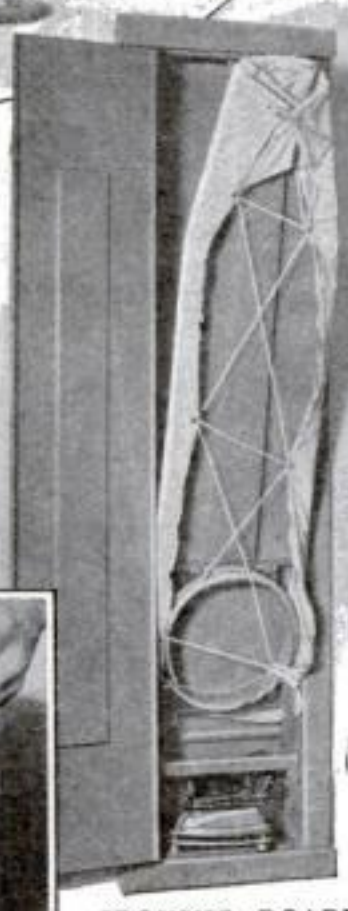
DRY CLEANER FOR THE HOME. Here is a miniature washing machine and dry cleaner. When the case is rocked back and forth by hand, as shown, suds or cleansing solution are forced through the fabric. Made of light metal, it can be placed on the stove and water boiled in it. The rocker base is detachable and when not in use is kept in the tub. The suitcase handle on the cover affords a ready means of carrying the washer from one place to another.

DOES EVERYTHING TO PIES. With this little contrivance, the housewife can bind her pies, trim the edges, and cut off extra dough.

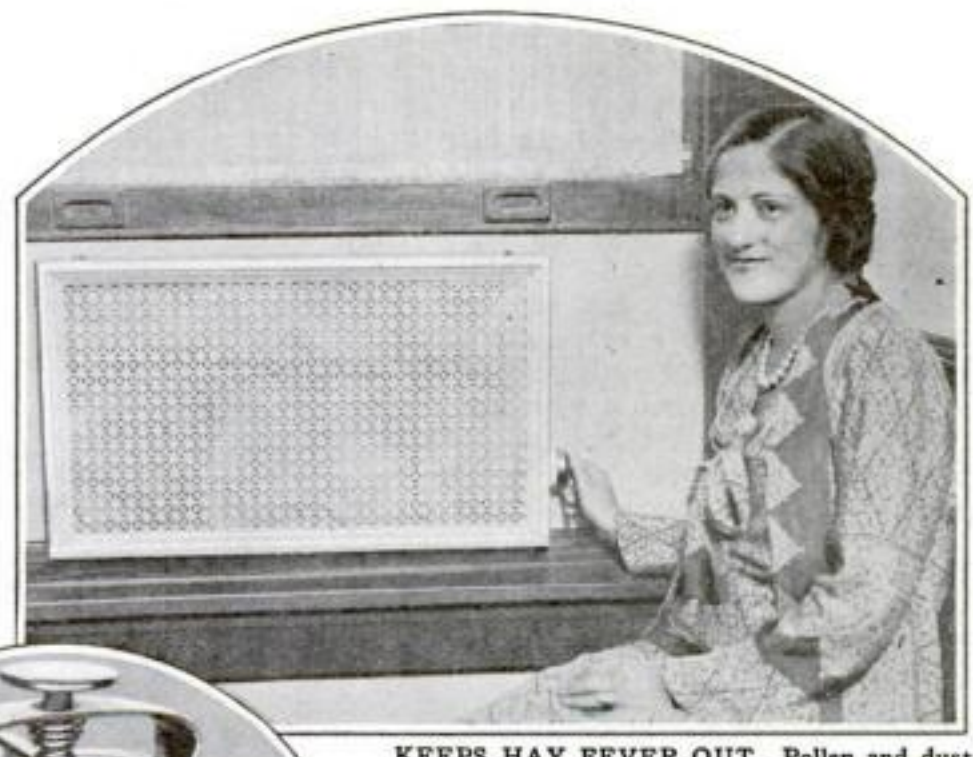
MEAT CHOPPER ON LEGS. Simplicity is the keynote of this food chopper which has a capacity of one and a quarter pounds per minute. In addition, it stands on its own four legs, is self-cleaning and self-sharpening, and is built to withstand wear.

VANISHING IRONING BOARD. Made of steel, this ironing board is built into its cabinet in the wall of your kitchen or laundry. It cannot warp or burn and has no supports to take up room in a limited space, and when not in use it folds in cabinet.

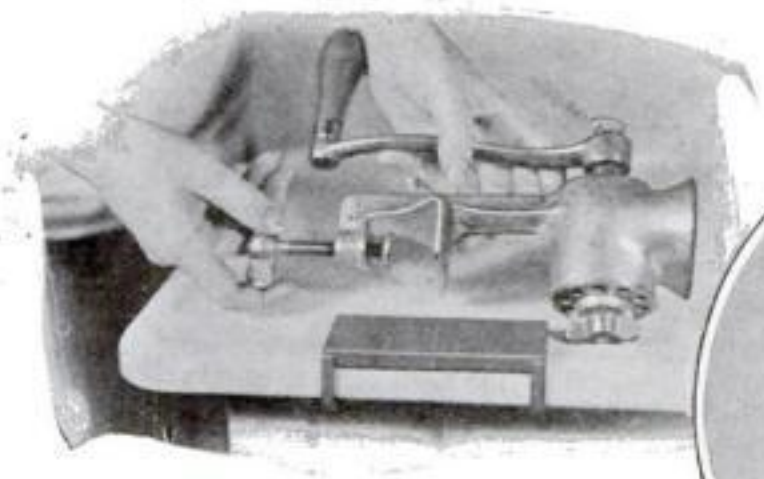
TURNS UP LID OF CAN. Attached by vise grip to edge of table, this can opener, with a few turns of the handle, rims out the lid and turns it up so that it can be handled safely.



IRONING BOARD CABINET. Hinged to a supporting base, this ironing board, when not in use, fits snugly into a cabinet in the wall.



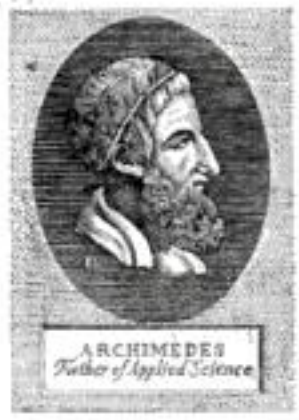
KEEPS HAY FEVER OUT. Pollen and dust that bring on attacks of hay fever are barred from the room by means of this screen. An electric motor operates an outside fan which forces air through a filter screen. It can be attached to any window and plugged in socket.



SAVE YOUR TABLE EDGE. Meat choppers, can openers, and the like attached to the edge of your table may crack the enamel and mar the surface. This protector fastens to the table edge by means of two spring clips and not only prevents marring of the wood or enamel but affords a firm foundation against which to clamp the meat grinder by making the edge of the table level.

SANITARY MILK CAN OPENER. Pick or knife points that may not be perfectly clean need not be used to pierce top of milk can if one of these little tools is handy. A plunger, with a bar having a puncturing point at each end, is forced through the top of the can. When not in use, the holes are effectually plugged by inserting the points, rubber tipped, into the holes.

Popular Science
MONTHLY



RAYMOND J. BROWN, *Editor*
ARTHUR WAKELING, Home Workshop Editor
ALFRED P. LANE, Technical Editor
ISRAEL DOSKOW, Art Editor

Published Monthly by Popular Science Publishing Company, Inc., 381 Fourth Avenue, New York City. Single Copies Twenty-five Cents. In the United States and Its Possessions and in Canada, $2.50 the Year. In All Other Countries, $3.00 the Year.

Who Owns the Air?

THEORETICAL ownership of the land, the ground under it, and the air above it would mean all rights in a section of space beginning at a point in the center of the earth and extending upward in a cone that would ultimately take in an area of infinite extent including a few million stars with their attendant solar systems.

Obviously such a conception of a man's property rights in the air above the ground he owns is ridiculous. The line must be drawn somewhere. The fellow who insists that his back yard includes a couple of dozen universes is asking too much!

The property rights in the ground under a piece of land have been pretty thoroughly thrashed out in court cases arising out of mineral rights, mining operations, and so on.

But what about the airplane? Theoretically an airplane can't fly without committing theoretical trespass on somebody's property. And there's no doubt but what he has committed actual trespass if he flies low enough to scare the property owner's livestock or perhaps stir up a noxious cloud of dust.

Eventually the laws will be made to conform to the physical requirements of aviation with due regard for property rights. Some arbitrary height limit must be set. Planes flying below that limit will be committing legal trespass. Above it, the landowner will have no claims.

Perhaps there may even be a definite schedule of indemnities for forced landings on private property with smaller amounts awarded for flying monkey wrenches and dumped gasoline.

Police and the Radio

WHEN any revolutionary invention is placed before the public, the first flush of enthusiasm over the idea often produces amazing results. The new device is put to uses for which it isn't in the slightest degree adapted, uses that any one with a grain of common sense would see could be handled better by methods and apparatus already well known.

Radio, because of its glamor and novelty, has had more than its share of this particular variety of nonsense.

All sorts of silly ideas for using radio in police work have been solemnly proposed by men who should know better. Many politicians looking for a little free publicity proposed new ways for the police to use radio—usually to accomplish a purpose already thoroughly covered by telephone, telegraph, teletype, or flasher system.

Radio undoubtedly is of vital importance in police work. Cruising police cars can be kept informed of important items direct from headquarters by radio. No previously known method of communication could do this. The sensible ideas separated from bunkum are in the article on page nineteen.

Beating Submarine Tragedies

PROGRESS demands that every apparently feasible idea be tried out to see if it is as good practically as it is theoretically. In certain lines of endeavor, notably medicine, surgery, aviation, and transportation in general, the practical tests involve more or less risk to human life. This risk is, of course, warranted if no way can be found to avoid it, but common sense demands that every precaution be taken.

The United States Navy is, therefore, to be commended for the remarkable method of training submarine crews and testing submarine rescue devices developed by Naval officers and described on page forty.

Under Your Hat

APPARENTLY, Professor A. Stinder, a Berlin, Germany, savant, thinks that this going-without-a-hat craze has gone about far enough. As many people in this country agree with him, it is interesting to learn what he has done. He has started an investigation to ascertain what goes on inside a hat when it is on the wearer's head—that is to say, physically, not mentally. To this end, he fashioned a small thermometer to be worn inside the headpiece. One hot day he found that the temperature inside a panama was only seventy-seven degrees, while the mercury outside was hovering around the not-so-gay nineties.

With characteristic German thoroughness, Professor Stinder so far has forborne to draw any definite conclusions. Now he is investigating the interior temperature of hats under all sorts of meteorological conditions, including air temperature, sunlight, and humidity. He even has designed a special apparatus to measure humidity under the hat.

Naturally, we await the outcome of his researches with interest. But as the no-hat vogue counts most of its adherents among the college men of this country, we are still more anxious to know whether the donning or doffing of a hat has any effect on brain activity, and if so, in what way.

Out to Conquer the Air

MASTERY of the air really is one big problem made up of a multitude of little ones.

These problems are now being tackled from many different angles. The article on page fifty-six detailing Hawley Bowlus' experiments in the study of bird flight is an example of how intensively an individual may seek a solution of some of the basic problems by prying into Nature's guarded secrets.

On page twenty-six is described a totally different method of approach. Here, a group of men are trying to work out a way to apply the scientific principles of the rotor ship to an airship.

And on page thirty-eight we find experimenters concentrating their research on a single important phase of flying—the mastery of fog by creating acceptable substitutes for human vision.

In the end, it doesn't make a bit of difference whether these particular experimenters are successful. If a sufficient number of inventors work for a sufficient length of time, every obstacle to flying eventually will be pushed aside.

Stopping a Big Waste

NO MATERIAL in its natural state, except certain foodstuffs, is of any particular value to mankind. You can't eat iron. You can't clothe yourself with it. There's nothing you can do with it except, perhaps, use it as a primitive weapon of offense or defense.

Materials become useful only when they have been fabricated into definite shapes; and the value of any raw material is, therefore, only potential. It is worth something not for what it is, but for what it can be made into.

A dress or suit of clothes may become unwearable because of style changes. An automobile may lose its value for the same reason. The actual loss of material has little to do with it.

In view of these basic facts, the pictures on page sixty-one are particularly interesting. They show that an earnest effort is being made to salvage the material in discarded automobiles.

If such complete salvaging of materials could be applied to all lines the effect would be revolutionary.

HELPFUL HINTS FOR RADIO FANS

Inside Secrets of a Vacuum Tube

Input Energy Is Like Gasoline in Motor and Grid Is Throttle—Where the Broadcast Hum Comes In

A CLEAR understanding of what goes on inside a radio vacuum tube will prove helpful to any radio beginner and experimenter. Studying the actual operation, and comparing it with similar action in other machinery with which you are more familiar, is the easiest way to master the subject.

In the illustration on this page, the action in a vacuum tube has been analyzed and reduced to its simplest terms. A comparison is made with the functioning of an automobile motor.

The essential parts of a vacuum tube are the cathode or electron producing element, the grid, and the plate. The base is merely a mechanical accessory that makes it easy to use the tube. The glass is needed only to keep out the air or in other words to permit the elements to operate without interference from air molecules.

Although the modern alternating current operated vacuum tube appears more complicated, its operation actually is easier to understand than that of the battery operated tubes. This is because the current that heats the cathode of the alternating current tube plays no part in the electrical functioning of the tube. Its job is to supply heat, and if there were any way to accomplish the result in a practical manner, the cathode would work just as well if it were heated with a gas flame.

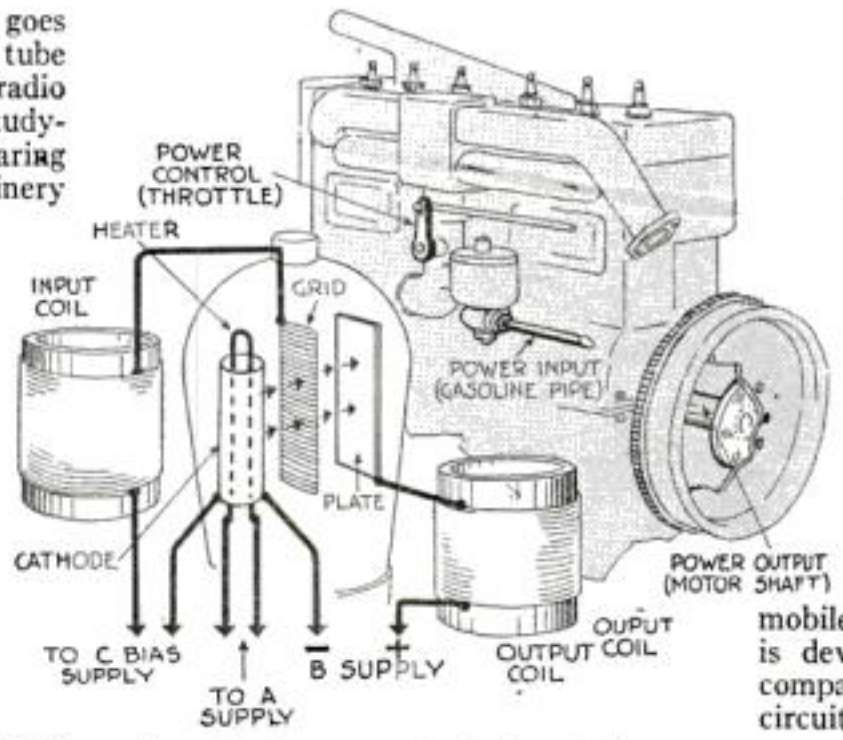
The type 227 heater tube is typical of general purpose alternating current tubes. The cathode consists of a tiny tube which is coated on the outside with certain metallic salts which, when heated, produce a copious flow of electrons. Inside the tiny tube, but not in electrical contact with it, is the filament. Surrounding the tube is a coil of fine wire called the grid, and outside the grid is the cylindrical plate.

In the drawing, the grid and plate are shown flat merely to make the action clearer.

When the current is forced through the filament, the latter becomes red-hot and heats the cathode which, in turn, throws off a stream of electrons. The electrons are negative and they are therefore attracted in a steady stream to the plate, which is the positive. This results in a flow of current in the plate or B circuit.

To get to the plate, the electrons must pass through the grid. Changing the electrical potential of the grid with respect to the cathode will regulate the flow of electrons. The C battery is used, therefore, to adjust the voltage of the grid, called the C bias. Almost no current flows in the C circuit; the C battery therefore lasts as long as it would on the dealer's shelf.

When an electromagnetic impulse is applied to the input coil, the voltage of the grid is changed and there is a corresponding change of greater magnitude in the current flowing in the output coil. It doesn't make a particle of difference whether the input and output coils are windings in a radio-frequency transformer or in an audio transformer, because the action is the same in either case.



Clear idea of vacuum tube is given in diagram in which its parts are compared with motor.

Comparing this action with that of an automobile engine, the input energy may be called the gasoline supply.

The throttle may be compared to the grid; and the C bias voltage, which regulates the normal flow of current, is on a par with the idling adjustment of the throttle, which keeps the motor turning over when no power is needed.

The crank shaft of the automobile engine is the point at which power is developed and it may, therefore, be compared with the output coil of the tube circuit.

A B C's of Radio

THERE is no such thing as a perfect conductor of electricity nor is there a perfect insulator. Even silver, which is a better conductor than copper, offers some resistance to the flow of electric current. Hard rubber, mica, bakelite, and other high-grade insulators allow a measurable quantity of current to leak through.

The higher the voltage the greater the current leakage through any insulator. Hence the amount of insulation needed on high voltage current is greater than for low voltage. Furthermore, if the voltage is made high enough, the resistance of any type of insulator will break down.

BROADCAST HUM

MOST radio beginners are inclined to take for granted the high quality of the broadcasting from different stations. Actually, broadcasting has not yet reached perfection. The tone quality is almost invariably better on features that are picked up direct in the broadcast studio. There is always some loss in tone quality when the voice and music have to be sent hundreds of miles by wire line.

Furthermore, the studio apparatus may not always be of the best quality nor be in the best operating condition. If this is true of the largest and most prosperous stations, what can be expected of some of the smaller stations that are not fitted with the best of apparatus?

Few stations broadcasting today send out a wave that is totally free from hum. This broadcast hum is often unjustly blamed on the radio set which is, of course, innocent. Whenever you hear too much hum in the moments when the voice or music is off the air, try tuning another station. If the hum on the other station is less, then the first station is not broadcasting a hum-free carrier wave.

The tone control now featured on many receivers will often improve matters when the broadcasting is faulty. If there seems to be an excess of low or high tone frequency from the loudspeaker, the tone control may help to compensate. When the broadcasting is of the best quality, the tone control should be set at the neutral position. Any attempt to change the tone under such conditions results in what is actually distortion.

Radio Aims at Remote Control

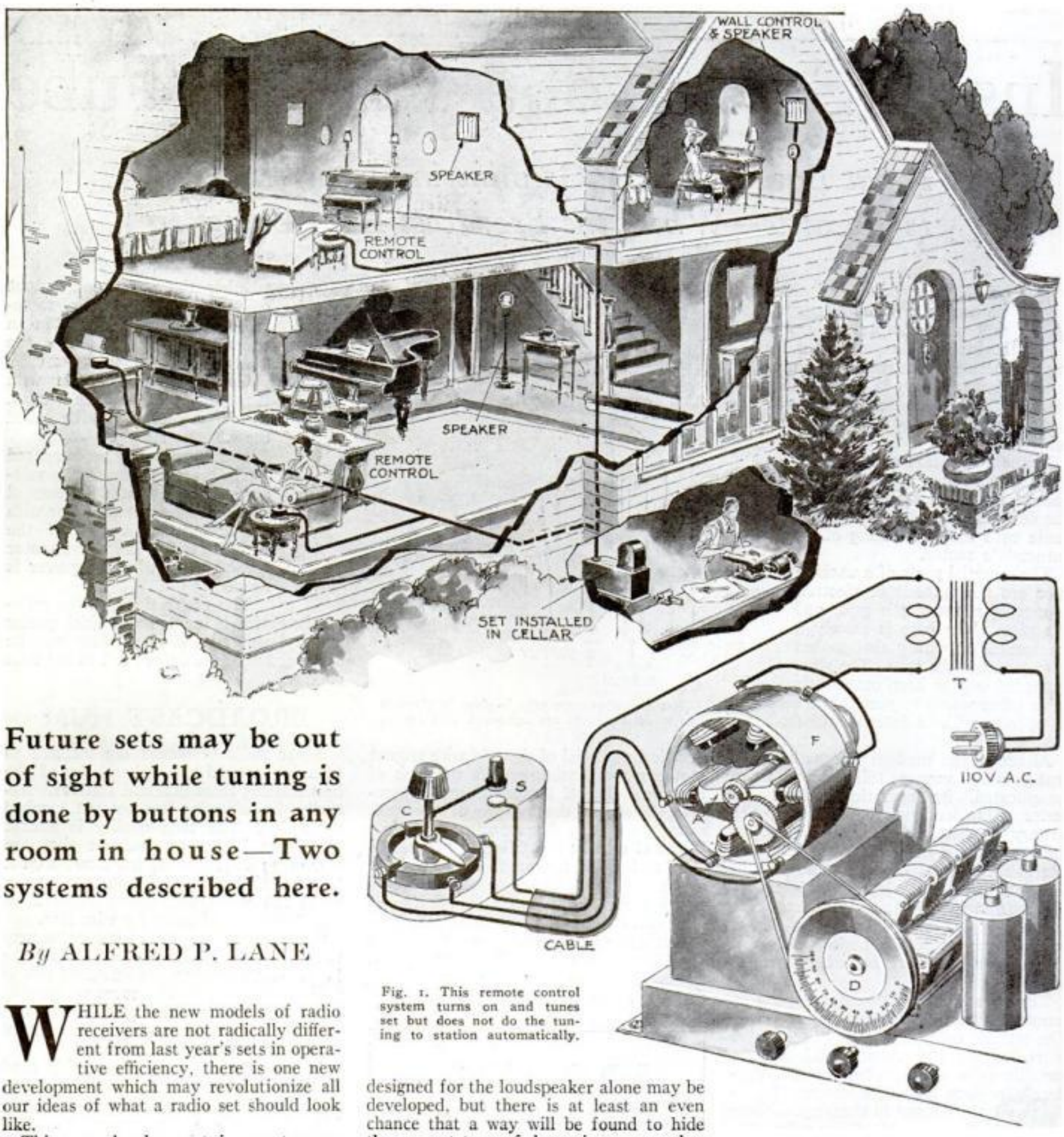


Fig. 1. This remote control system turns on and tunes set but does not do the tuning to station automatically.

Future sets may be out of sight while tuning is done by buttons in any room in house—Two systems described here.

By ALFRED P. LANE

WHILE the new models of radio receivers are not radically different from last year's sets in operative efficiency, there is one new development which may revolutionize all our ideas of what a radio set should look like.

This new development is remote control. It will be featured this year principally as an accessory to the conventional console cabinet radio receiver. But, if the idea of remote control captures the popular fancy, future radio receivers will no longer be housed in fine cabinets. They will lose their status as parlor ornaments. Instead, the same efficient types of radio chassis will be housed in plain metal boxes concealed in the cellar, closet, or out-of-the-way corner.

The loudspeaker, which now is placed in the cabinet with the radio set chassis, will become a separate accessory again as it was before the console cabinet became popular. Some form of cabinet mounting designed for the loudspeaker alone may be developed, but there is at least an even chance that a way will be found to hide the present type of dynamic cone speaker unit as a wall fixture or even build it permanently into the wall surface. Some manufacturers may mount their loudspeaker on a pedestal, like a floor lamp.

Like the modern central heating plant, where the boiler in the cellar supplies heat to the various rooms through concealed radiators, the radio of the future, itself hidden, will supply radio entertainment to any room of the house by way of concealed speakers in the wall of each room.

Specially built de luxe installations of this type have been made and it seems only a question of time until some manufacturer turns out, at popular prices, the necessary parts for such an outfit.

The problem of remote control of a radio receiver is much more complicated than the remote control of other devices. The lights in any modern home, for example, are almost universally remote controlled. The light in the hall upstairs can be turned on or off from the main floor, and so on. It would be possible to turn the radio set on and off with equal ease. The difficulty lies in arranging to tune it to different stations from a remote point.

TUNING a station necessitates the production of a mechanical motion in the receiver chassis itself. This motion must turn the shafts of the tuning condensers.

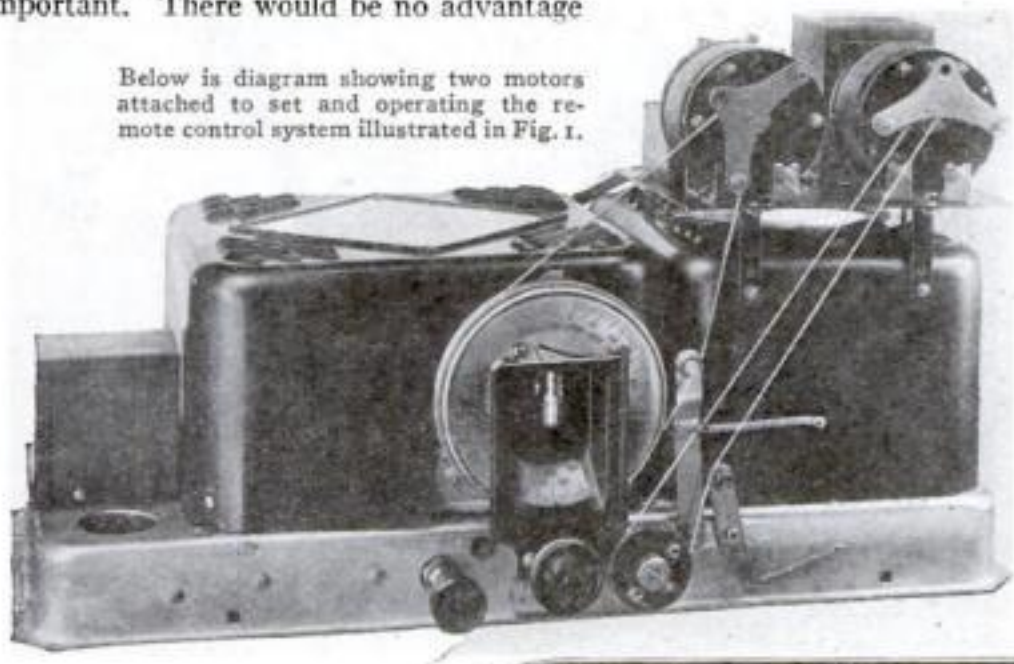
Furthermore, this motion must be accurately controlled so that the dial can be stopped at the exact point where the station is in perfect tune.

In addition, the volume control of the set must either be moved mechanically from a remote point or the volume control itself must be shifted to the remote point and connected to the radio set by way of extra wires in the control cable.

Summing up the problems of satisfactory remote control, we find, first, that the set must be turned on and off. Second, there must be complete control of the dial movement. Third, there must be complete control of the volume. Fourth, these operations must be possible from as many different points in the house as desired.

The fourth requirement is especially important. There would be no advantage in constructing a remote control that would operate only from one point. You might just as well place the radio set at that point and not bother with the remote control at all.

Below is diagram showing two motors attached to set and operating the remote control system illustrated in Fig. 1.



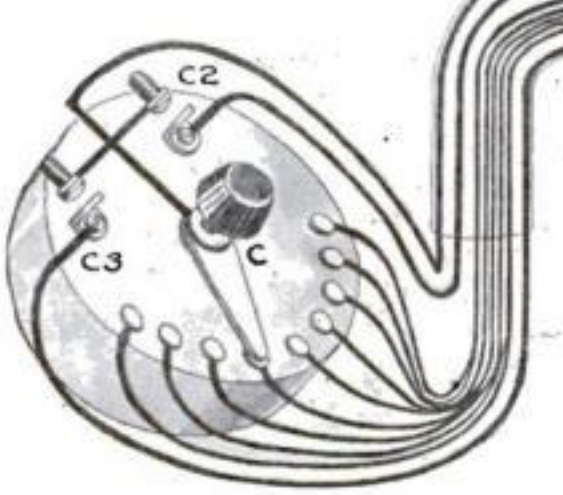


Fig. 2. A control system that automatically tunes the set to any one of a number of desired stations. In this scheme special buttons control the tuning of the set between determined points.

THE solutions of the various problems of remote control as worked out in the systems now available are extremely ingenious.

Turning the set on and off is usually accomplished by fitting a switch to the condenser shaft at the zero tuning position. To turn off the set it is only necessary to turn the remote tuning control to zero.

Rotating the tuning dial is always done by a small electric motor. In some systems a separate motor also is fitted to operate the volume control.

The radio receiver shown in Fig. 2 is thus fitted for remote control. The driving motors used are special and the diagrammatic circuit of this particular system is shown in Fig. 1.

The ring-shaped field of the motor *F* has six poles with opposite poles connected in series. One lead from each set of poles is connected to one terminal of the secondary winding of a small step-down transformer. The other three wires leading from the three sets of poles are connected to the three segments of the controller commutator *C* by way of the connecting cable. The contact of the controller is connected by way of a switch button *S* to the other terminal of the step-down transformer winding.

THE armature of the motor is not wound. It is geared by means of reduction gearing and a cord belt to the condenser dial drum *D*.

When switch button *S* is pressed, current flows through whichever segment of commutator *C* happens to be in contact and so through the windings of the pair of poles connected to that particular segment. The armature *A* is immediately pulled into line with the poles thus magnetized.

When the commutator contact is rotated by the knob on the remote control box in which it is located, the current flows successively through each pair of pole pieces and the armature *A* therefore is dragged around and around to correspond with the revolutions of the control knob. Thus the dial drum *D* is rotated to tune in different stations.

If the knob is rotated in the reverse direction, the armature is, of course, pulled around the opposite way.

A small dial is mounted in the control box. It is geared to the control knob with the same ratio employed to gear the armature *A* to the dial *D*. In actual practice double reduction gearing is used instead of the single pair of gears shown in the drawing so that it takes many revolutions of the control knob to rotate the condenser dial on the set through the full wave band. This results in what amounts to a fine vernier action.

Of course tuning a system of this type is exactly like tuning the set itself. You must turn the control knob until the dial number for the proper station is in line with the indicating pointer.

SINCE current flows through control commutator *C* only when switch button *S* is pressed, it is obvious that any desired number of remote control units can be wired to the same controlling motors in the set. No matter where the dial was left by operating the control box in one place, it can be turned to any desired position by pressing the button and turning the control knob at any of the other control points.

A similar control commutator operates another special motor to work the volume control. In Fig. 2 the tuning control special motor is the left one of the pair shown mounted on *(Continued on page 144)*

Expert Advice on Auto Lighting

"Too bad I can't put thirty-two-candlepower bulbs in these headlights," Gus said. "It's the latest thing to use bigger bulbs everywhere in a car now."

Electrical Engineer Learns from Gus That Things Not Found in Books Happen to Cars

By MARTIN BUNN

"AND so I decided that there must be something wrong with the generator and that's what caused the lights to burn out," the car owner concluded positively.

He had drifted up to the Model Garage out of the blackness with all lights out, like a smuggler's boat creeping into port.

Instead of raising the hood and immediately starting to work on the generator as the motorist quite obviously expected, Gus Wilson, veteran auto mechanic and half owner of the Model Garage, began to argue.

"What makes you think it's the generator, mister?" he questioned. "Maybe it's the ground connection on the storage battery."

"Rats!" snorted the car owner. "I'm an electrical engineer. Don't you think I know something about my car's starting and lighting system? The starter works perfectly. If the ground connection will carry a couple of hundred amperes of current to operate the starter, it can't be in bad shape."

"Lots of funny things happen to autos that aren't in the books," Gus grunted as he pulled up the floor boards.

"Hey, Joe!" he called to his partner, Joe Clark. "Plug in the extension cord and bring the trouble light out here, will you?"

Gus grabbed the handle of the storage battery and pulled on it. He could lift it almost a quarter of an inch.

"Loose batteries will always cause trouble if you let 'em go long enough," he said half to himself as he loosened the battery terminal of the ground cable.

"Take a look at this, mister," he directed, offering the other the frayed end of the ground cable which had broken off about three inches from the battery.

The car owner looked puzzled as he fingered the frayed end.

"I can't believe it!" he exclaimed. "It just isn't possible to start a car with the ground cable broken. Say, you didn't break that cable yourself?" he questioned in sudden suspicion.

"I didn't have to," Gus grinned. "The loose battery, bouncing around when you went over bumps, did that. When the car was standing still and the battery stayed down where it belonged, the broken ends of the cable pressed together so the starter could turn over the warmed-up motor. If you'd let it alone and tried again tomorrow with a cold motor, it probably wouldn't have swung it past compression. Did you notice the lights get brighter a couple of times before they finally burned out?"

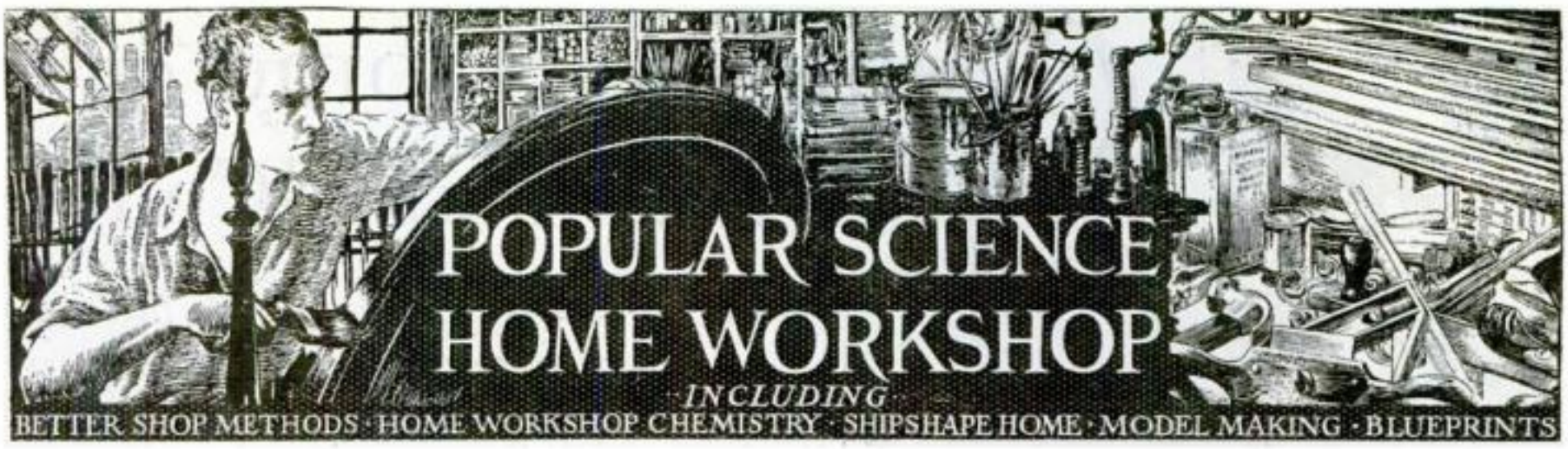
"Every time I went over a bump they flashed up," the car owner admitted. "They finally burned out when I bounced over the car tracks just down the road. I hit them going pretty fast."

"If you'd stayed under twenty miles an hour after you first noticed 'em flash up," Gus suggested as he finished bolting a new ground cable in place, "you could have got here to have it fixed without wasting the price of a new set of bulbs."

"I should have thought of that," the car owner admitted. "If I'd kept the speed down to the point where the generator wasn't producing such high voltage, when the ground circuit opened on the bumps, the lights wouldn't have flashed up from the overload." *(Continued on page 145)*

Letter Contest Winners

ON PAGE 144 you will find the names of the winners of the cash prizes in the letter contest about cars, announced in our August number. Every possible reason for buying an automobile was mentioned in the letters we received. I am sorry space limitations prevent me from printing them. Because of the high quality of the letters an honorable mention list, which will be found with the cash prize list on page 144, has been added.—MARTIN BUNN



Ten Shots at a Clip with This *Easily Constructed* TOY MACHINE GUN

By H. V. PATTERSON

A spring plunger discharges one bullet at each turn of the crank.

"OH, SON!"

"Yes, Dad?"

"Come down here to the basement workshop. I have a great idea."

He came on a breathless run, and I explained that the night before, while he had been playing war, I had noticed the fine wooden cannon his friend Jack was using.

"He was knocking down all of your soldiers, but you weren't doing so well with that old tin cannon of yours. I was thinking that perhaps we could make a machine gun that would shoot BB shot. Here are some sketches I have worked out. What do you think of them?"

"Say, Dad, they look swell, but how does the gun work?"

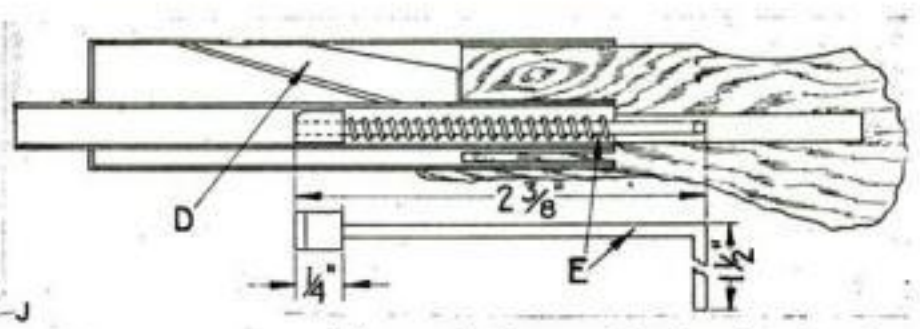
"Well, you load it here, where I have marked *A* on this sketch. I figure that it will hold about ten BB shot. As you turn the crank, the plunger is pulled back just far enough to let one shot drop into the barrel. The instant the shot is in place, the plunger is released, and the gun is fired. Let's get busy."

We began with the barrel, which I have marked *B*, making it from a piece of ¼-in. copper tubing 3⅜ in. long with a 3/16-in. hole drilled in it 1⅞ in. from the end. The radiator or outer barrel *C* was made from a 3-in. length of ¾-in. copper tubing with a 3/16-in. hole drilled ¾ in. from the end as at *A* for loading. The front end was later closed up with tin.

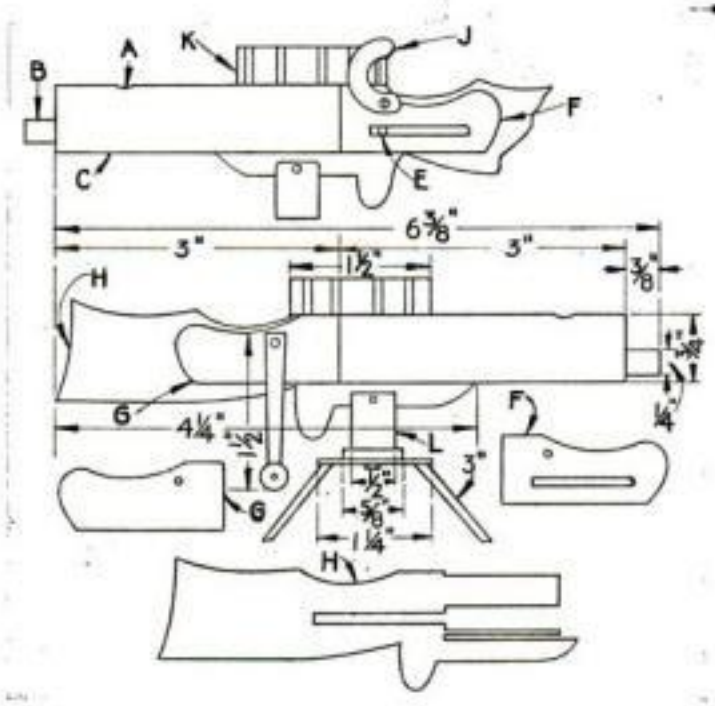
For the magazine *D*, we bent a small piece of tin trough-shape and soldered it inside the radiator so that the BB shot would roll down and drop into the barrel. The plunger or firing pin *E* required a piece of No. 12 wire 3⅞ in. long and a bit of lead. We bored a 3/16-in. hole in a ¼-in. board, and my son held the wire upright in the exact middle of the hole while I ran molten lead around it, after which we dressed it down to fit the barrel. The 3/16-in. diameter coil spring was put in place and then we bent the plunger exactly 2⅜ in. from the front end.

The left-hand plate *F*, the right-hand plate *G*, and the stock *H* were cut from ¼-in. plywood. We were going to make the crank from a strip of iron 1/16 by ¼ by 1½ in. until my son suggested using the crank and handle from a broken fishing reel. A ¾-in. washer cut in half served for the cam or hammer *J*; it was fastened to the crank with a 1/16-in. bolt. The hole for this bolt was located 7/16 in. back from the front edge of piece *F* and ¼ in. above the slot. Pieces *G* and *H* were drilled to match.

A wooden dummy magazine *K* was added. Then the ½ by 2 in. swivel *L* was cut from tin, and 1/16-in. holes were drilled in the middle and each end for bolts before it was bent U-shape. This was bolted, with a washer between, to a tripod made by soldering three 3-in. lengths of No. 9 wire to a 1½-in. disk of heavy tin.



The completed gun, a drawing of the interior construction, and a detail of the plunger.



The sketches from which the tiny gun was built. Few of the dimensions, however, are vitally important.

Golfing *at* Home *on a* 9-hole Parlor Course

How to build a set of hazards for both indoor and outdoor use

By GEORGE H. VAN WALTHER

Playing the "narrow fairway." This is the obstacle for the first hole of the course, which has some tricky hazards.

FORE! No longer need that cry die with the coming of winter, for you can now have a miniature nine-hole golf course, hazards and all, right in your own living room. How simple becomes the problem of entertaining guests when you have nine interesting holes of golf stored away on the top shelf of your hall closet! In the spring, the course can be set up on the lawn or in the back yard, allowing you to carry your pygmy golf activities through the spring and summer months.

The nine obstacles that make up the course are easy to build and can be made from scrap boards or packing-case lumber. While the stock shown in the drawings is designated as being ½ in. thick, any size will serve so long as it is strong enough to stand the usage that the obstacles will receive. As for tools, a hammer, fret saw, hand saw, and plane are all that are needed.

The obstacles are assembled with 1-in. brads, which can be toe-nailed slightly for additional strength. Liquid glue also can be used in the joints, if desired. Since the drawings are self-explanatory, there are only a few points which need be specially mentioned.

Dowels, ½ in. in diameter, serve as the legs for the two parts of obstacle No. 8. These are glued into ½-in. holes placed perpendicular to the faces of the boards which form the inclines. The dowels used as hazards in obstacles Nos. 2, 3, 5, 8, and 9 are ¼ in. in diameter.

Notice in obstacle No. 2 that the runways taper from 12 in. at the ends to 8 in. at the top where the two pieces come together. In setting up the course, this obstacle is placed so that the runway having the pegs is nearest to the tee and the other points toward the hole.

In the "water hole," No. 4, which resembles an arched bridge, wall board is used for the floor of the runway since it is easily bent to the desired curve. The side walls fit over the top of the wall board and are held in place with 2-in. brads, driven through the wall board and into the sides.

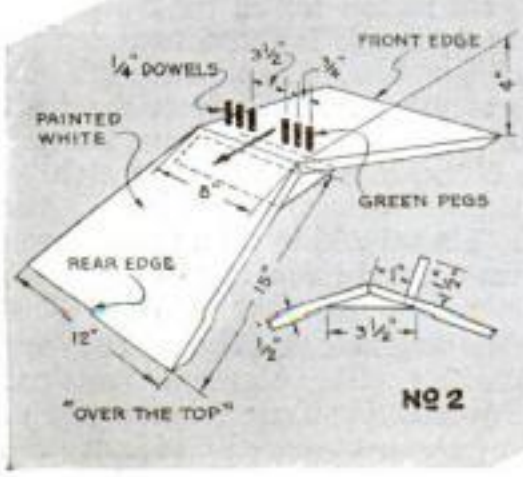
If desired, the hedge in No. 6 can be cut from wall board also, but wood is recommended, especially if the course is to be used out of doors where the obstacles will be subjected to a certain amount of moisture.

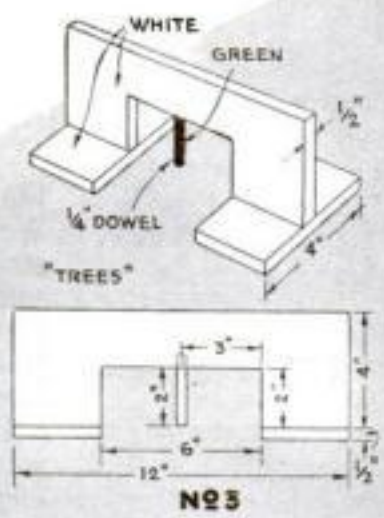
Obstacle No. 5 is designed to retard the progress of the ball as it passes through. The seven ¼-in. dowels are drilled ½ in. from one end and are threaded on a 10-in. length of stiff wire. Small wood or glass beads are used between the dowels to supply the proper spacing. The wire can be supported by setting the ends into grooves cut in the sides or by fastening each end to the back of the sides with wire staples. Be sure that the dowels fit loosely on the wire so that they can swing freely.

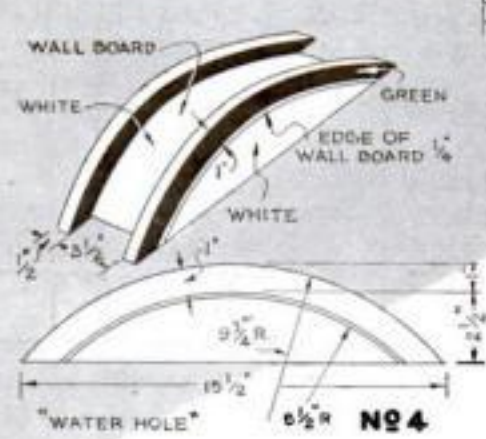
In making the legs for obstacle No. 8 see that the second and smaller runway fits under the first and larger one in such a way that the ball, after going through the 2½ in. diameter hole, will fall into the runway and roll in the general direction of the hole.

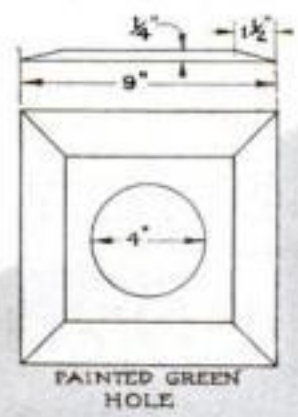
Much of the success of obstacle No. 9 depends on how carefully the front and back edges are beveled. This precaution applies also to the indoor holes. Plane them down smooth so that the ball will not be turned from its course by any unevenness.

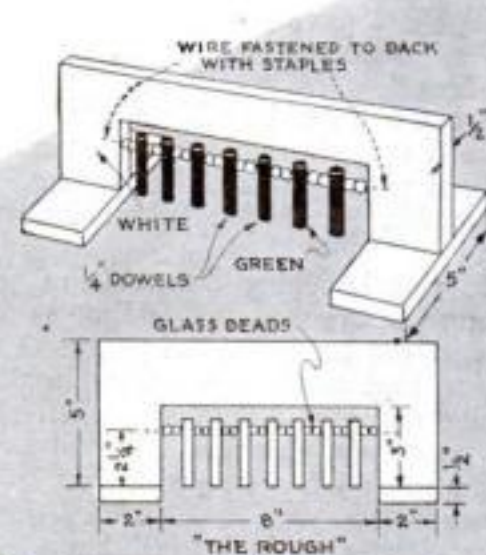
After all the obstacles are assembled, sandpaper them thoroughly and fill in any holes or irregularities with a wood putty.











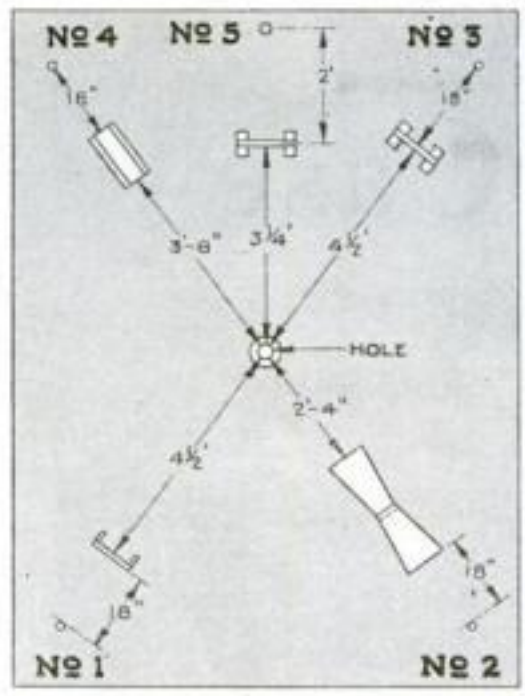
Obstacles Nos. 2 to 5 and one of the "holes." The hazards from Nos. 6 to 9 and one of the tee markers are shown on the opposite page. Wood, wall board, and dowels are the materials.

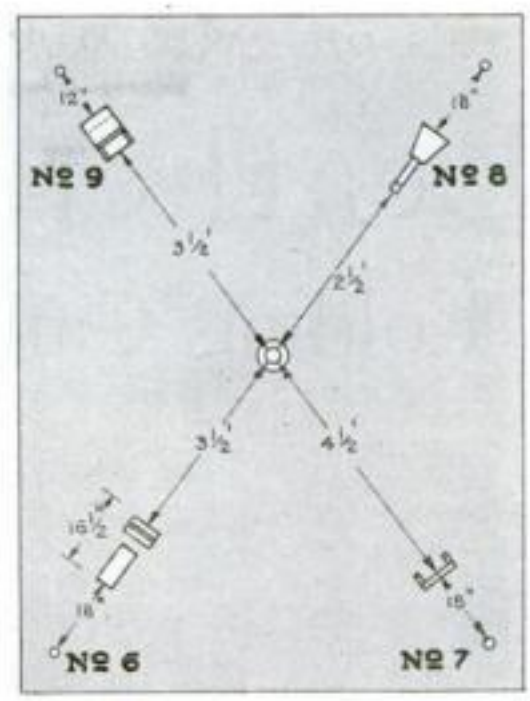
As to finishing, the color scheme is wholly a matter of choice; a good combination is a background of white with grass green trimming. Two coats of either enamel or flat paint should be sufficient.

With our obstacles finished and placed aside for drying, we are ready to plan a layout for the course. The one shown in the diagrams at the right uses only two holes and can be set up on two 9 by 12 ft. rugs. This type layout is ideal where two rooms are close together. Of course, a hole can be used with each obstacle, if desired, by zigzagging the holes back and forth across the rugs, but the use of but two holes reduces the amount of construction work and does not in any way detract from the interest of each hole.

The same system can also be used when the course is set up on the lawn or, if preferred, real holes can be cut in the ground and tin tomato or soup cans placed in them to form the metal cups. The cans should be at least 4 in. in diameter and should be set in so that their upper edges are ¼ in. below the surface of the ground.

Although not altogether necessary, square pyramid-shaped tee markers, such as shown, will add to the appearance of the course and will also show those not familiar with your course just where the next tee and obstacle are. These can be made of scrap lumber and can be painted white with green or black numbers.





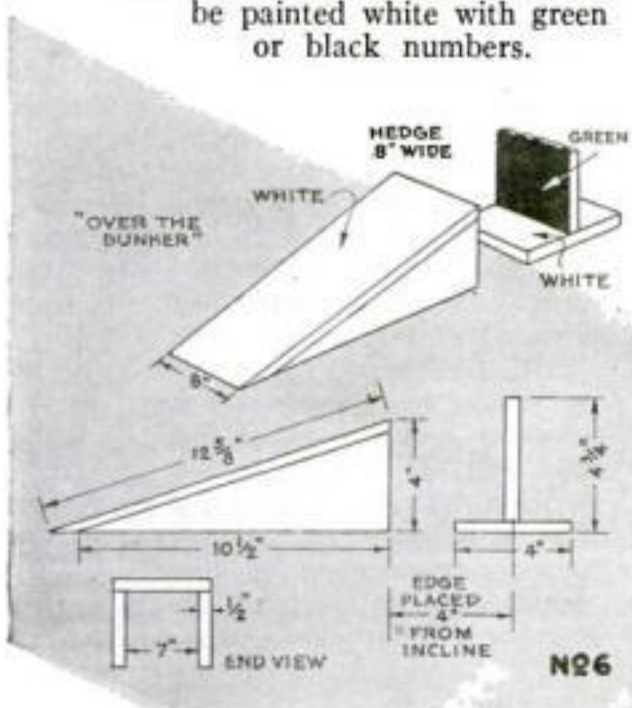
A suggested arrangement for laying out the course on two rugs 9 by 12 ft. in two adjoining rooms. If preferred, a separate hole may be used with each obstacle.

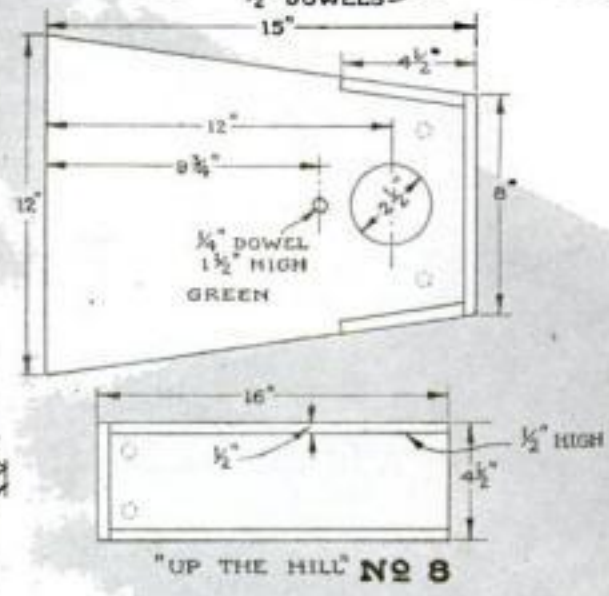
In all cases, excepting Nos. 9 and 5, the front end of the obstacle is placed 18 in. from the tee or starting point. No. 9, being a more difficult obstacle, is placed 12 in. from the tee, and No. 5, being an easier obstacle, is placed 2 ft. from the tee. If the course is to be used out of doors and regular holes are to be set flush with the ground, you can supply each hole with a realistic marker by attaching small triangles of red muslin to the ends of nine 3-ft. lengths of ½-in. dowel. The other end of each dowel should be sharpened so that it can be driven into the ground just behind the hole. The numbers can be painted on the flags with white enamel. These flags, together with the tee markers that you will use indoors, will give your outdoor pygmy course a truly realistic appearance. By exercising a little ingenuity, your course can be made quite attractive and colorful.

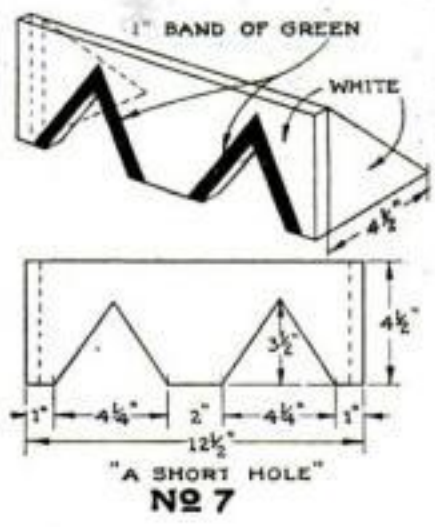
With the course all made and set up, there is little else to do than to get a putter and a supply of secondhand balls and read the rules.

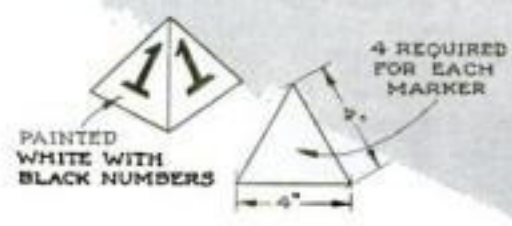
Rules of the Game

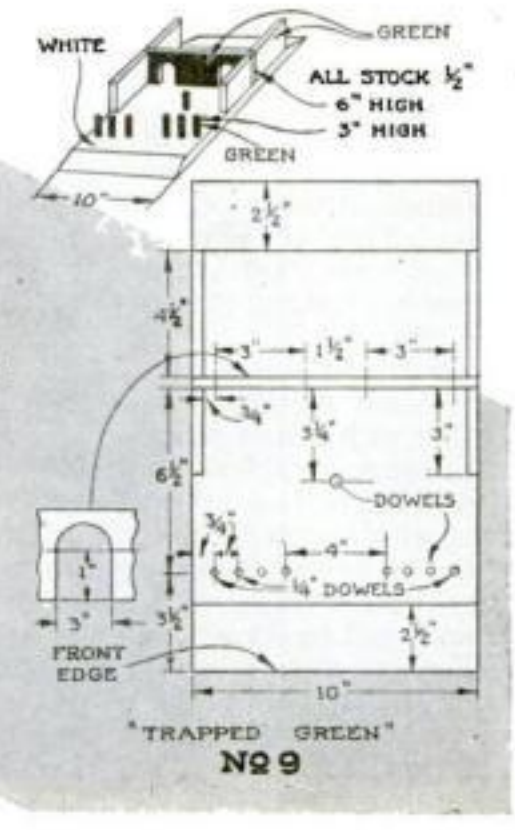
1. In playing each hole the ball must pass through each obstacle, not around it. In No. 1 the ball must pass through hole. In No. 2 it must roll up incline and through opening between pegs. In. No. 3 it must pass through either opening. In No. 4 it must roll over bridge. In No. 5 it must pass through opening. In No. 6 it must roll up incline and jump hedge, landing on the hole side. In No. 7 it must pass through either opening. In No. 8 it must roll up incline and pass through hole. In No. 9 it must roll through opening between pegs and through either opening in the fence.
2. When an attempt to put the ball through the obstacle fails, the ball is placed at the starting point, one is added to score, and another attempt is made.
3. If the ball is not holed-out in a maximum of ten strokes, the player must take that as his score for that hole and proceed to the next.
4. A ball is not considered as being holed-out until it remains in the hole.
5. Each player is allowed to finish the hole before the next player begins.
6. If the ball rolls off the rug or lawn, it is placed at the point where it rolled off and played from there without extra penalty.
7. If the ball rolls into an unplayable lie after having passed through the obstacle, it can be placed anywhere without penalty so long as the distance from the ball to the hole remains the same.
8. The man having the lowest score on the preceding hole leads, the second highest going second, and so on.
9. Only one club, the putter, is allowed each player.
10. In No. 6 the ball is not considered as having passed through the obstacle unless it comes to rest on the hole side of the hedge.











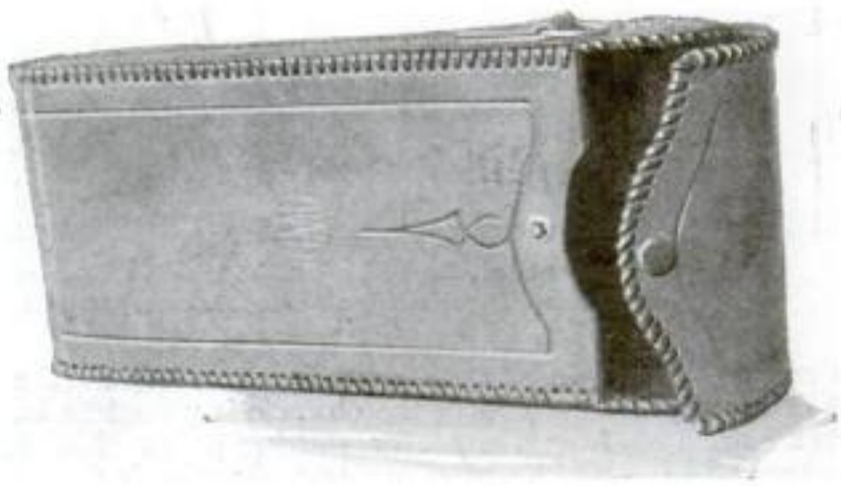
Midget Golf for Christmas

HERE is a hint for the man who likes to make Christmas gifts in his home workshop—build midget golf sets. Can you think of any other type of novelty that is as easy and inexpensive to construct, yet will give so much fun? Paint the sets neatly, box them attractively, and they will be ideal gifts.

F. CLARKE HUGHES *on how to make a*

Fine Leather Case

for a Folding Camera



Have you ever tried leather craft work? It is not difficult and requires few tools, and this camera case is a good project to begin with.

BECAUSE of the rough treatment it receives, the carrying case purchased with a kodak does not, as a rule, last nearly as long as the camera itself. For this reason, many folding cameras, after being used for a few years, are without cases. It is not difficult, however, to make a sole leather case to fill just such a need—a case that will look well and will stand hard knocks for many years without showing signs of wear.

Three pieces will be needed for making the case. One is a long strip for the body of the case, which is marked *A* in the accompanying drawing; and the others are smaller pieces for the ends, marked *B*.

The first thing is to measure your camera and draw a layout on tough cardboard. Then cut these parts to shape and fasten them together temporarily with paste or glue at the corners so as to make sure that the case, when finished in leather, will be exactly the right size to fit the kodak. The careful cutting of these patterns will sometimes save time and material by preventing mistakes.

When you are sure the patterns are correct, you can measure them and purchase the necessary leather. It should be a good grade of sole leather such as may be obtained at any shoe repair shop. In thickness it should be about ⅛ in., and uniform throughout, with the face side free from spots or scratches.

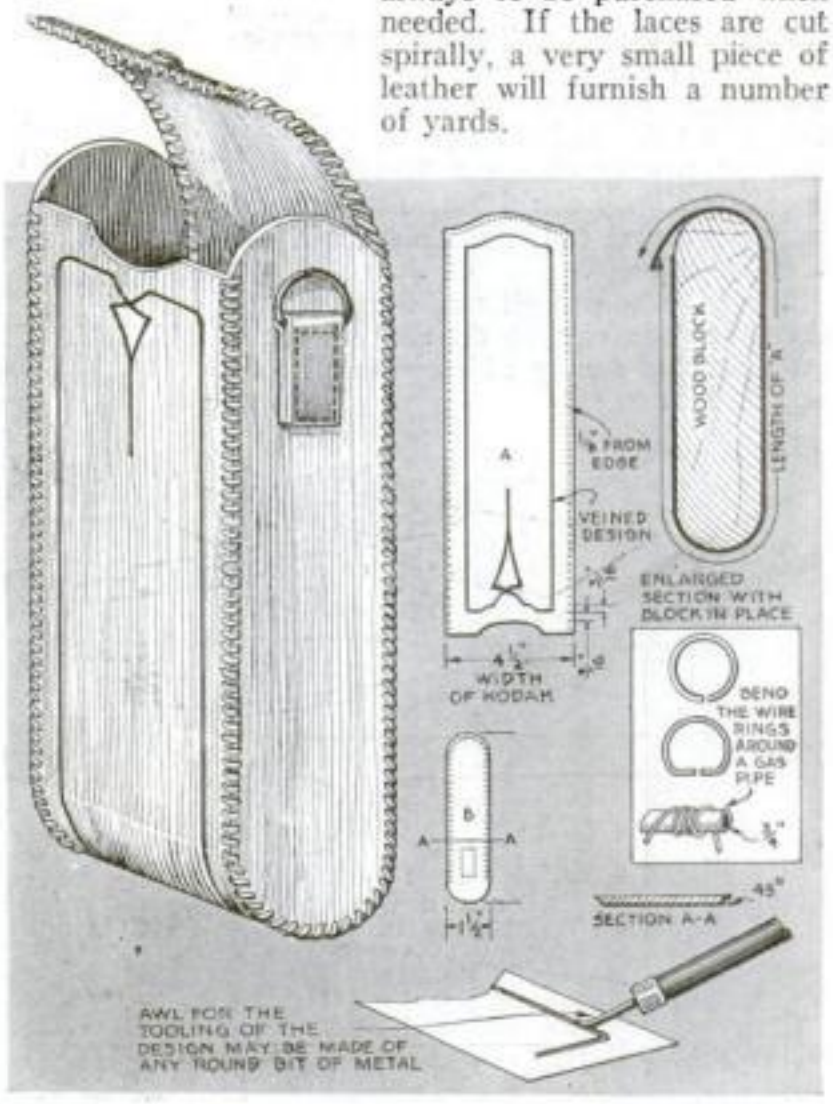
Lay out the holes on each of the three parts, keeping them ⅛ in. from the edge and 3/16 in. apart. If it is desired to carry the lacing around the top of *B*, as shown in the upper photograph, punch holes all around the edge; otherwise stop the punching as indicated in the drawing. After punching, miter all the edges which are to come together as shown in the detail marked "Section *A-A*."

The next step is to mark the design on the damp leather with a lead pencil.

The pencil will leave a decided impression in the surface, which should be deepened with a steel tooling awl. If the awl is heated to the temperature of an ordinary iron when used for pressing, the grooves will be deeper and more lasting.

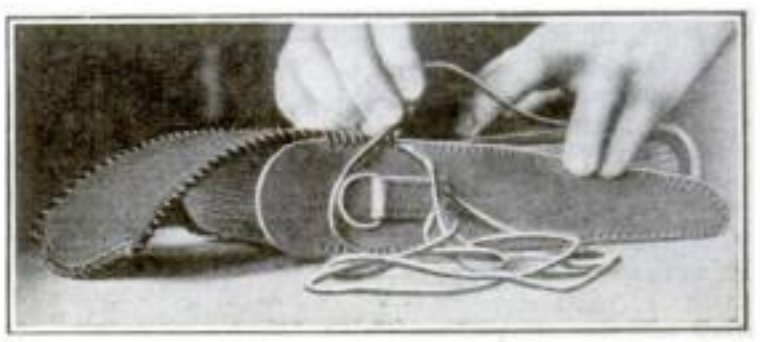
The two rings should be made as indicated and attached to the sidepieces of the case with plain stitching of the usual size and type, as has been described in several previous articles (P.S.M., July '30, p. 106; and Aug. '30, p. 102).

Before attempting to do the lacing, prepare a wooden block of the same size and shape as the camera. The laces, which are usually about ⅛ in. wide, are cut from either goat or kid skin. Wallaby skin is the preferred stock, but it is not always to be purchased when needed. If the laces are cut spirally, a very small piece of leather will furnish a number of yards.



The case consists of one piece *A* and two ends *B*, cut to fit the camera. Note how the pieces are punched, the edges mitered, and the wire rings made; also the tooling.

As the last step in the construction, take the case to a shoemaker and have a snap fastener applied. Then shellac the corners lightly to cement the joints and give the lacing a more highly finished appearance. When the shellac is dry, polish the whole case thoroughly with ordinary floor wax or shoe dressing.



If the holes are accurately laid out and punched and the edges are neatly beveled, the lacing process will prove a simple matter. A wooden form is used to hold the case in shape.

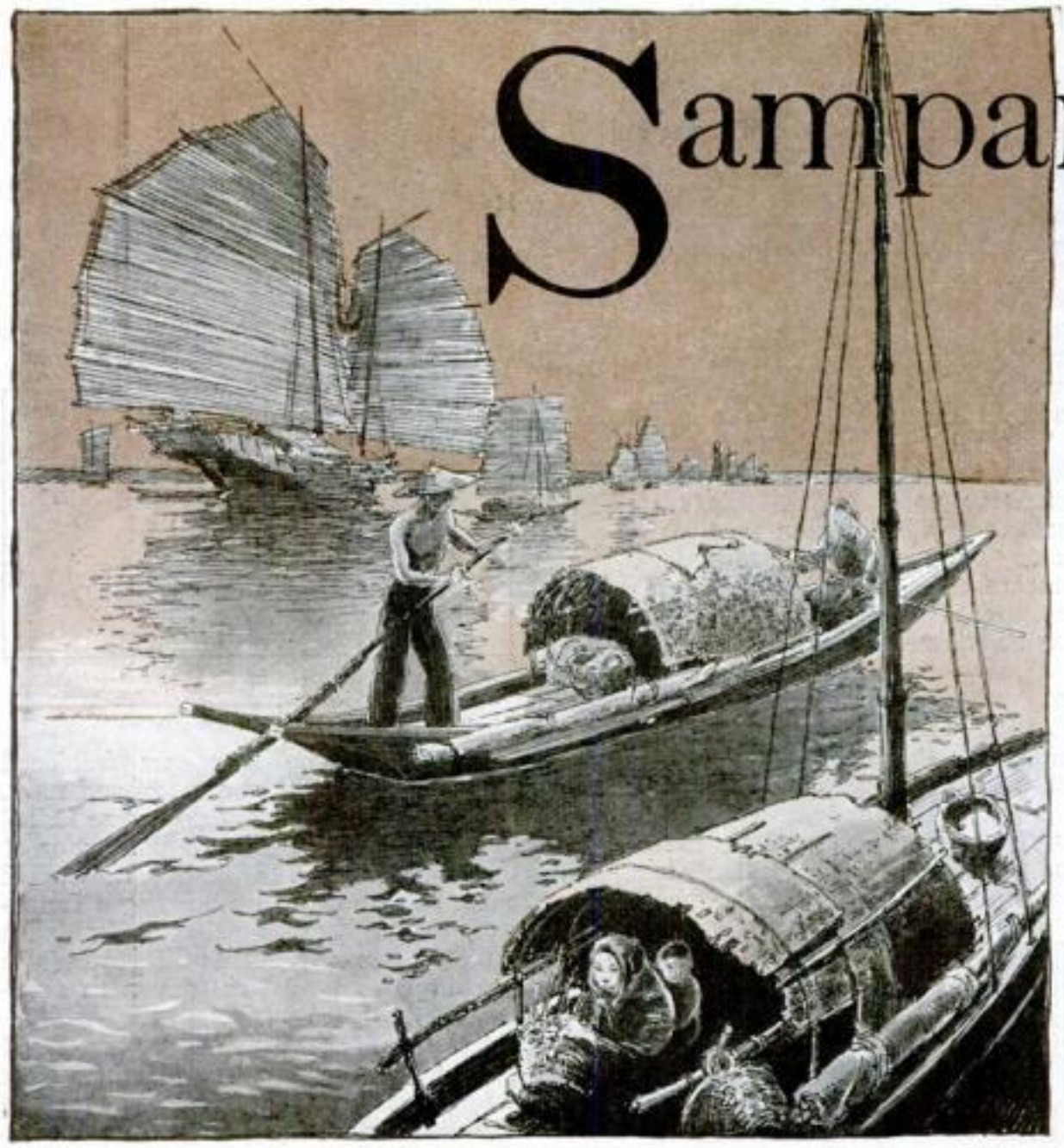
STRIPING COACH MODELS

WHEN the stripe lines on a miniature stagecoach or similar model are reduced to the proper scale, they are so narrow that it takes more than the steady hand and skill of an artist to draw them.

Obtain some thin gummed paper or ordinary large gummed stickers with red borders. With a steel straightedge or a draftsman's celluloid triangle and a broken razor blade, cut a number of strips about ⅛ in. wide, doing the cutting on a sheet of glass to insure a clean edge.

Stick the strips in pairs to the side of the painted model wherever a stripe is to be made, the gap between them being the same width as the stripe desired. With a small brush charged with the desired color of paint or lacquer, paint a more or less regular narrow band of color over the opening between the paper strips. When the paint has thoroughly dried, moisten the gummed paper with a wet sponge and pull it carefully away.

Complicated curved stripes may be made just as easily. Pencil the curve on the gummed paper and cut it accurately. Then trim each half-sheet to a width of about ⅛ in. along the curved stripe line and stick them to the model, keeping the spacing uniform.—ALBERT W. EIDMAN.



The sampan, one of the picturesque little craft that ply the waters of the Orient. Chinese families in some instances live throughout their entire lives on small boats of this type.

Sampan Model

Illustrates a Novel Way of Making Hulls

By

E. ARMITAGE McCANN

HERE is a new and easier way to make a yacht or ship model hull by jig-sawing all the sections or "lifts," as they are called, from a single board, one within the other, and then telescoping them out to make a hollow, troughlike form from which the main hull can be carved with the least possible work.

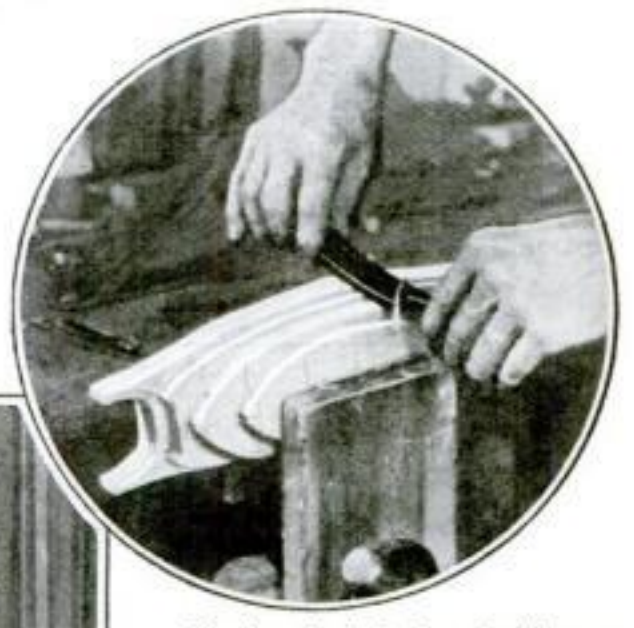
A study of the accompanying illustrations will make the method clearer than any amount of explanation. The model used as an example is a Chinese sampan or rowboat. It was made entirely with a motorized woodworking outfit, mainly the jig saw, sanding disk, and drum sander, and a rotary file for the necessary hollowing inside the hull. The same work, of course, can be done with hand tools with the exception of the jig-sawing, which really requires a machine so that the correct angle can be maintained throughout.

The advantage of this new method will be better appreciated if it is compared with the two standard ways of shaping a hull. The most workmanlike procedure, of course, is to build the hull of ribs and planks like a real vessel. This, however, is a big undertaking and too difficult for most of us. The second method, which is the one ordinarily used, is the so-called "lift" or "bread-and-butter" plan by which a series of layers are cut to shape, glued together, and then hollowed. This is the method shown in most of the POPULAR SCIENCE MONTHLY ship model blueprints (see page 113). While it is very much simpler than the rib-and-plank method, it still entails a lot of cutting and uses a considerable amount of valuable wood.

The new process does not waste any wood; furthermore, it reduces the labor because a single saw cut serves for both the inside of one section and the outside of the section below. The completed hull consists of layers, but instead of being glued face to face, they are glued edge to edge, the joints running vertically instead of horizontally.

The wood used must be at least half as thick again as the desired depth of the lifts, and is better if twice that thickness. For example, if the lifts are to be ½ in. thick, the wood should be 1 in. thick or thereabouts.

As you will do the sawing with the bottom of the plank uppermost, the lines you draw will be the lower edges of the lifts. This should be remembered, although it does not make any difference in the shape or position of these lines.



Shaping the hull after the lifts are glued. A hull of this kind can be trimmed very thin with safety.

Cutting one lift within the other. The manner of adjusting the saw table is shown at the top of the following page.

The table of the jig saw must be set at a slight angle to the saw blade and if it is not of the tilting variety, a supplementary table should be made from a board and two wedge shaped blocks. The angle will be about the thickness of the saw cut. It can be ascertained accurately only by experiment. Take a piece of scrap wood of the same stock as your lifts and saw a little circle in it. Remove the inner piece and mark the desired depth of the required lifts; then push it through the outer piece and see if it comes through to the mark when tight. If it does not, adjust the saw until you

find the correct angle, with a very slight allowance for glue in the joint—a very little for casein glue, a trifle more for liquid glue, and still more for carpenter's hot glue.

One lift can be made deeper than another by varying the angle of the saw; the greater the angle, the less the depth. The outside top lift will have the full depth of the wood, but this is an advantage because that part of the hull is the most vertical, and you can cut the sheer (deck curve) in it, although this can be cut through into the next lift if necessary.

If a jeweler's blade is used, the hole for starting it is so small that it does not matter where it is bored, but the stem is the best place; bore it at the required angle. With a pin blade a bigger hole is required, so bore it just outside the line at the stem or stern end, whichever slopes the most. It will be filled later with a ready-mixed wood putty.

The lift should be completely sawed out in one cut, if possible, in a direction so that the underside of the wood is the larger. If the wood is too long for the sweep of the saw frame, bore holes at each end and saw about halfway along from each hole on opposite sides; then remove the wood with the saw blade in the cut, reverse it on the table, and tilt the table the other way until the blade is again upright and can be refastened. Now complete the sawing.

They say that "position is the art of gunnery"; so it is of jig-sawing. To keep evenly along the lines, which is very necessary in this work, get your best eye well down in line with the saw blade but not too close.

When all the lifts have been sawed out, mark the desired depth, push them through, and see if they come to the marks; if not, a little sandpapering can be done, but it is better by careful adjustment to avoid this. Brush glue on the inside and outside edges where the pieces are to be joined; then push the layers through to the marks, and set the hull aside for the glue to dry thoroughly.

The hull is now ready for shaving to the templates on the outside and trimming to the desired thinness on the inside. It will be even stronger than if made by the "bread-and-butter" plan because there is more glued surface and less fear of warping. A hull of this kind can be trimmed very thin with safety.

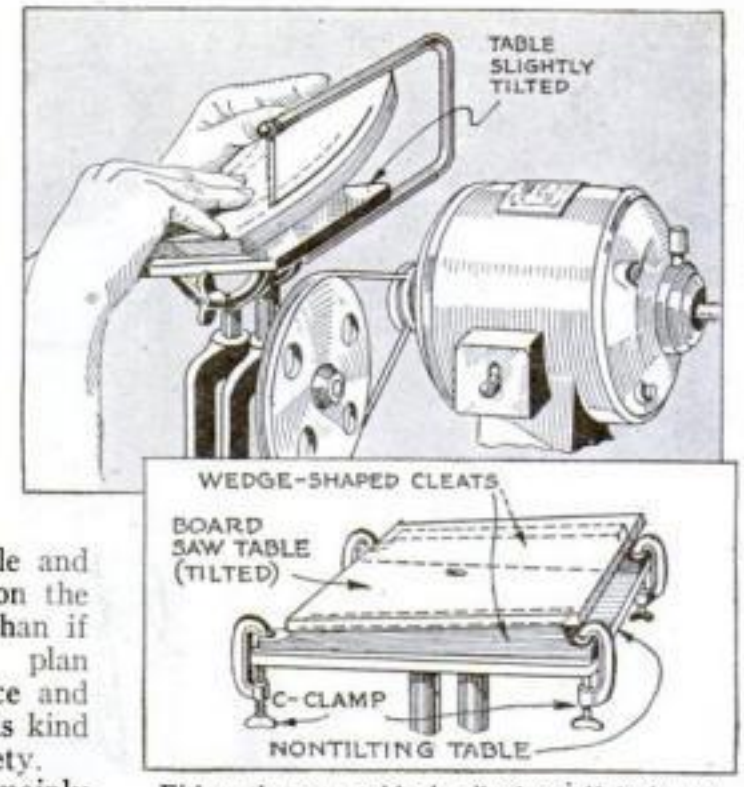
While we have used the sampan mainly to illustrate this novel method of hull construction, there will undoubtedly be some readers who wish to build a similar model and add it to their collection.

To complete the hull, add the top rails as shown in the perspective sketches of the bow and stern and in the sheer plan. As to deck fittings, these may vary. Many sampans had two long oars fashioned roughly from wood and a sail and mast. The latter, when not in use, were lashed to the side as shown in the illustration at the top of page 85. If desired, a thatched cover can be added by building a framework of thin bamboo and covering it with a piece of canvas from which threads in one direction have been drawn to simulate the thatched effect.

Color the sampan hull, oars, and thatched cover with a brown stain, adding a few smudges of black or gray here and there to give the appearance of wear.

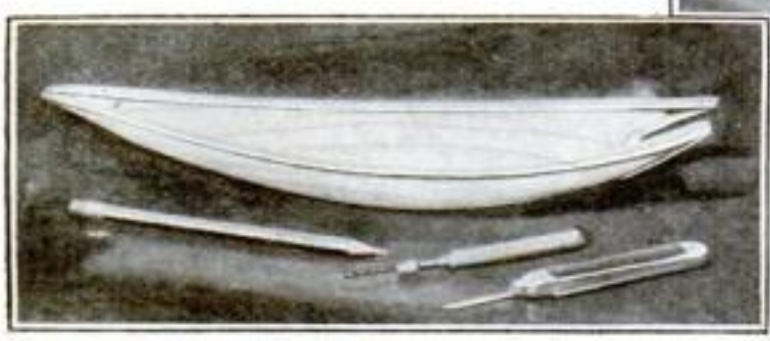
If you plan to build some other model by the same method and it happens to have high-wall (vertical) sides, it will be necessary to add a separate section to the top. For any vessel with tumble home (slope in from the water line) a second series can be made, meeting the first at the widest water line.

By this method other hollow objects can be made, such as bowls or deep trays.

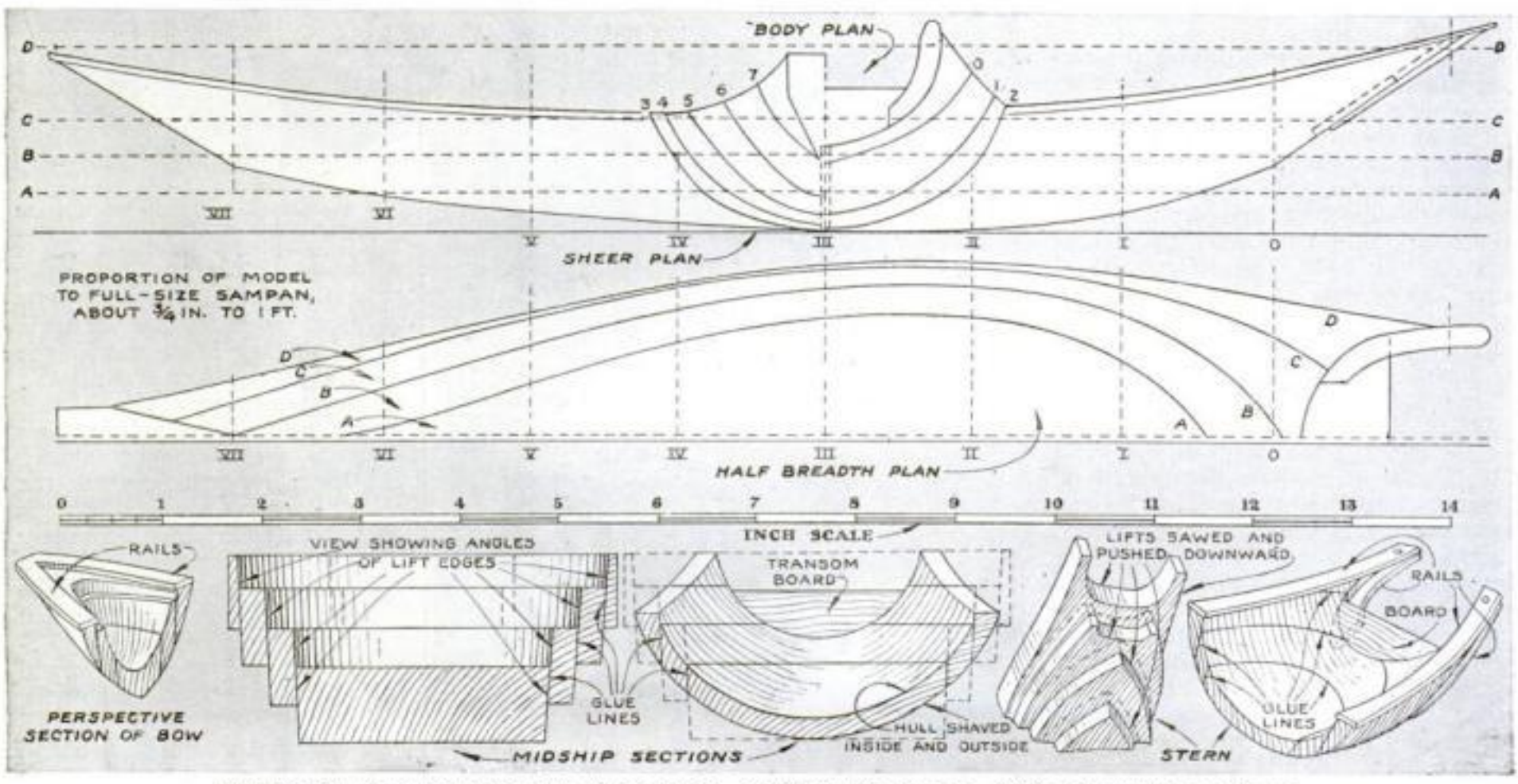


Either the saw table is tilted or, if it is not adjustable, a wooden auxiliary table is used.

Bottom view of the completed hull. The work of shaping it was greatly reduced by the new sawing method.



The finished hull with the rails in place. Note that they project a trifle at the stern and are met by short rails which curve up from beneath.



Half-breadth, sheer, and body plans of the sampan, and illustrative sketches. While this unusual model was chosen to illustrate the new method of hull construction, almost any type of ship model can be built similarly.

You *Can Build* a Screen Just as Beautiful as This

The construction is of the simplest and the cost can be what you please, since it depends mainly upon your selection of the covering material

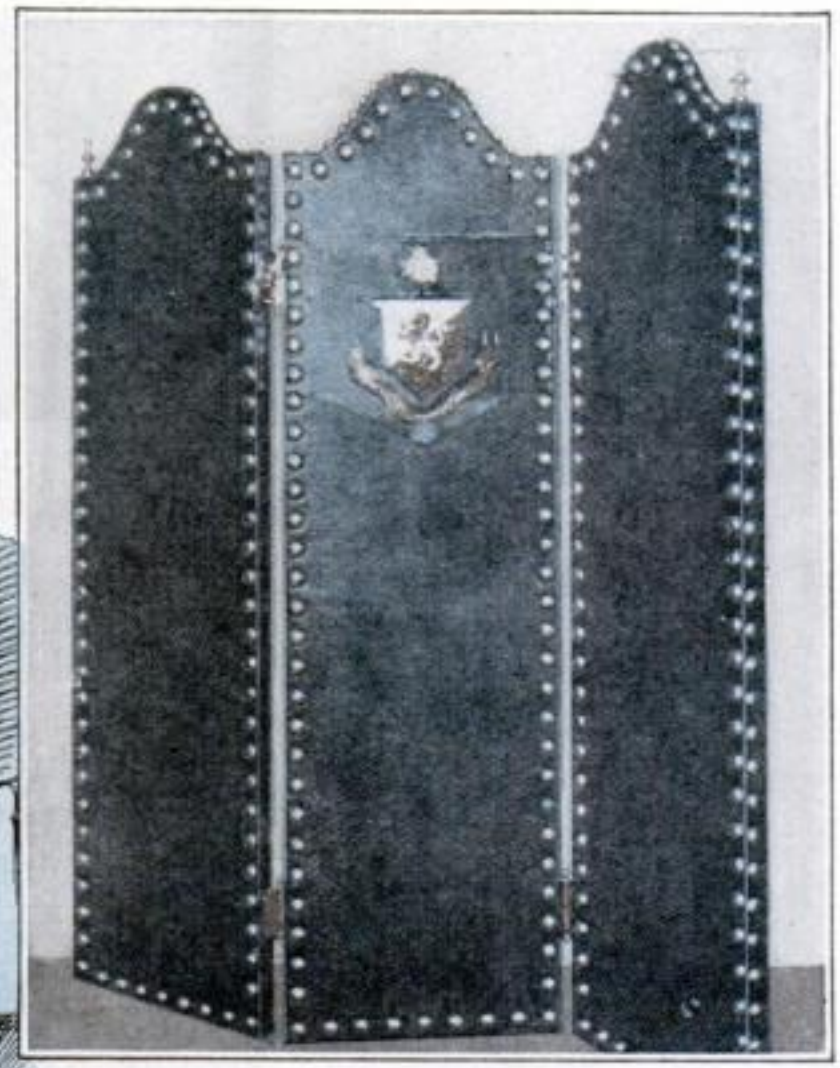
By PAUL LEO

TO BEAUTIFY a room and, incidentally, to conceal an unsightly doorway or other architectural defect, there probably is no other article of furniture as effective as a fine screen. And screens are among the easiest pieces to build, for they can be made with a few ordinary hand tools if power-driven woodworking machines are not available.

The Spanish leather screen illustrated, if carefully constructed of the materials listed, will equal commercial screens priced as high as $500. The actual cost of the materials used by the writer was $87.56, but this included an item of $40.20 for the finest grade of red, top grain leather, $15 for 500 gilt upholstery nails, and $12.60 for the lumber dressed and cut to exact lengths. The same design can be carried out successfully in imitation leather, cretonne, or any suitable drapery fabric; and less expensive materials can be used throughout.

The frame is composed of three identical panels of thoroughly seasoned, clear white pine (see drawing marked Fig. 1). All parts should be square and true. If sawed by hand, the pieces should be cut squarely and accurately to length in a good miter box. To avoid difficulty in mortising, the cross members are secured to the uprights by means of two dowels in each end (Fig. 2). A doweling jig is a valuable aid if the parts are blind-doweled as specified, although the dowels, being of small diameter, may be set right through the uprights and later cut off flush with the outer edges. Nails or screws should be avoided because they might interfere with the tacks. To insure maximum rigidity against the strains incident upon stretching the canvas, corner irons are used as shown in Fig. 1 and also in each bottom corner, ten irons to a frame.

ARMY duck of 10 oz. weight is carefully stretched and tacked on the outer edges only of the frame. Figure 3 shows the methods of overlapping and tacking the material to avoid interference between successive rows of tacks. No tacks should be driven in the sides of the frame because the heads would project and mar the appearance of the finished screen.



A screen of enduring beauty that would grace any room. It is covered with Spanish leather.

Materials for Screen

6 pcs. 1⅜ by 2 in. by 5 ft. clear, seasoned white pine.
12 pcs. 1⅜ by 2 by 14 in. white pine.
3 pcs. 1⅜ by 10⅛ by 14 in. white pine.
3 pcs. ⅜ in. by 3 ft. hardwood dowels.
30 corner irons, ⅛ by ⅞ by 3½ in.
120 flathead bright wood screws, 1¼ in. No. 9, for corner irons.
1 small can best grade liquid glue.
12 yds. 10-oz. army duck (sometimes called canvas), about ¾ yd. wide.
1 lb. No. 4 cut tacks, tinned, ½ or ⅝ in. long.
6 panels of leather as selected, at least 2 by 6 ft.
1/32 by 1 in. half-hard strip brass, 23 ft. 6 in. long.
6 oz. 7/64 by ¾ in. brass escutcheon pins.
2 pr. heavy bronze plated, double-acting springless hinges for doors (be sure to specify for doors 1⅜ to 1½ in. thick).
4 boxes (125 per box) roundhead polished brass upholstery nails, 1¼ in. in dia. (number actually required 456).
1 ⅜ in. dia. round brass rod, 1 ft. long.
¼ by 1 in. brass strip, 4 in. long.
8 flathead brass wood screws, ¾ in. No. 8.

NOTE: If curtain pole ornaments are purchased, eliminate last three items.

In applying the duck, square one end of the material and set a tack in the lower corner of the bottom edge of a panel, making sure that the selvedge is parallel with, and near the edge of, an upright member. Stretch evenly and tightly across the frame and place a tack in the opposite corner and one tack in the center, with intermediate tacks between. If any puckers appear, remove the tacks, stretch, and repeat. Neatness is essential. Cut square pieces out of the corners where the material is turned over at the bottom of the frame so that only one thickness of the material covers the wood.

NEXT, stretch the duck as lightly as possible lengthwise, placing a tack temporarily in the center of the curved top edge of the frame. Now follow the selvedge of the material from the bottom upward along the edge of the upright, stretching and tacking as you go. The cloth then should be stretched across the frame. Tack from the bottom upward and stretch diagonally across the frame and upward.

If this procedure is followed painstakingly, a perfectly flat and tight surface will result. It is necessary to use only one row of tacks placed near the edge of the material covering each side of panel.

The tack in the center of the curved top edge, temporarily driven, is now removed, as the material will probably

"RCA Radiotrons always in every socket"

says

COLIN B. KENNEDY

President
COLIN B. KENNEDY CORPORATION

"MANY unnecessary radio troubles are caused by inferior tubes. The finest receiver is handicapped by poorly designed and constructed tubes. RCA Radiotrons are the unquestioned standard of scientific achievement in this field. To insure clear Kennedy tone, and maximum Kennedy performance, we strongly advise 'RCA Radiotrons always in every socket.' We unhesitatingly recommend them to Kennedy owners."

This is the 24th in a series of endorsements of RCA Radiotrons by the leading radio set manufacturers.

RADIO ENGINEERS ADVISE:

Replace all the vacuum tubes in your radio set with RCA Radiotrons at least once a year. This is the only sure way to maintain good performance and minimize disagreeable noises and other troubles caused by inferior tubes. RCA Radiotrons will give you the maximum in selectivity, sensitivity and *tone quality.*

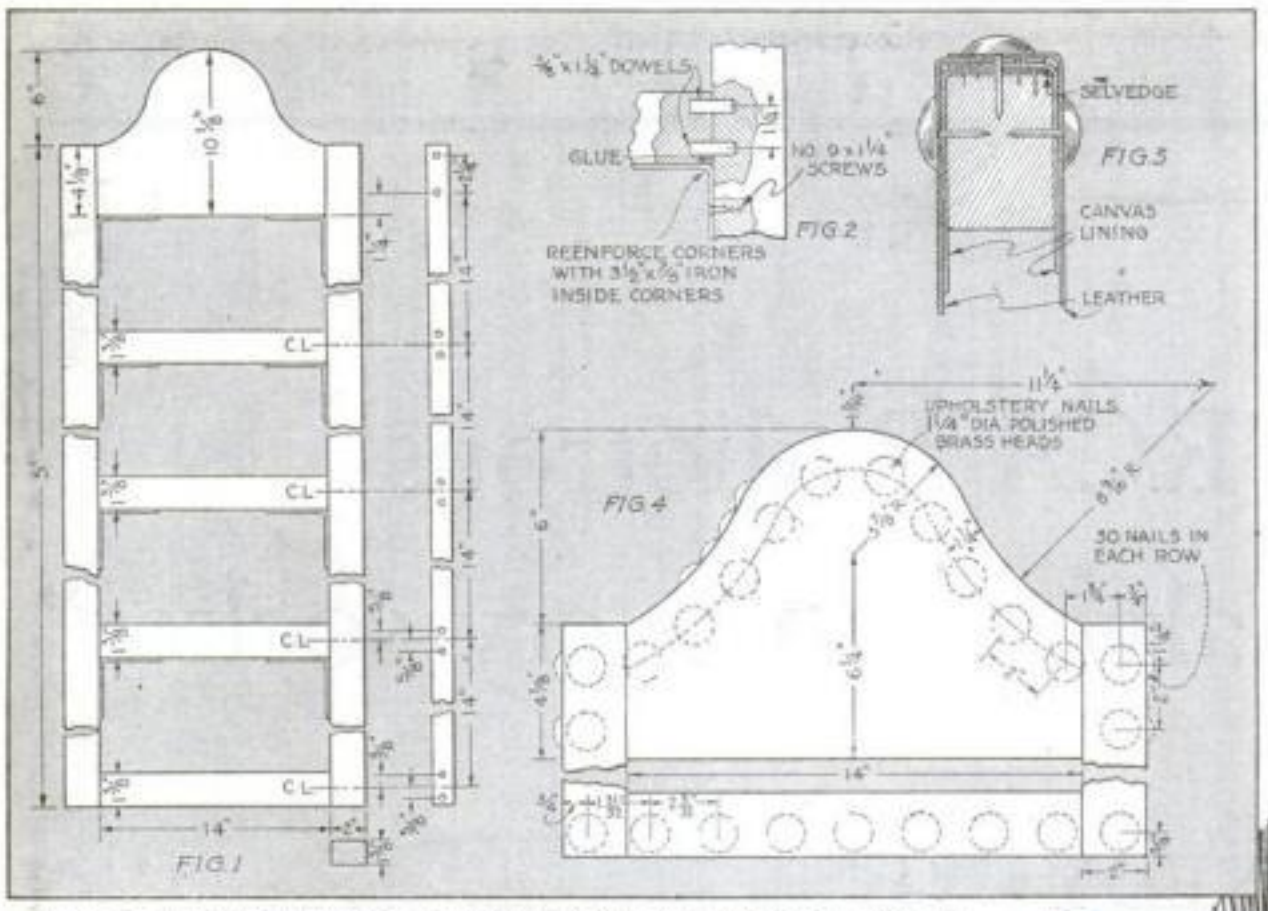
Old tubes may impair the performance of the new.

RCA RADIOTRON CO., INC., HARRISON, N. J.

RCA Radiotrons

THE HEART OF YOUR RADIO

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

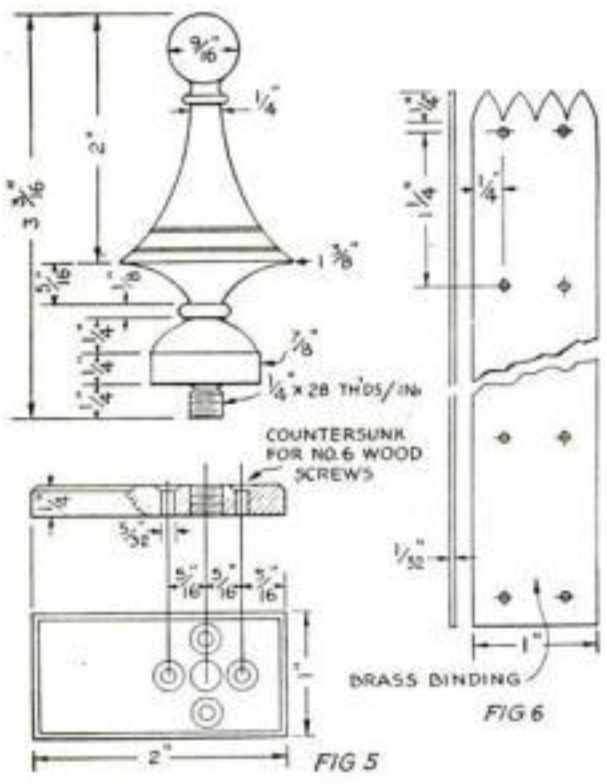


How each of the three frames is constructed (Fig. 1); doweled joints (Fig. 2); the method of tacking on the coverings (Fig. 3); spacing the nails (Fig. 4).

now admit of a little final stretching from the bottom upward.

Drive a few tacks at intervals to fasten the duck over the top edge, stretching the material tightly from the bottom upward. Make slits with scissors in the puckers near each tack on the curve. These slits should extend to the edge over which the material is turned. Cut out V-shaped pieces to eliminate these puckers, put a dot of glue under each angular tab that is left, and tack it down flush. Trim off the surplus duck from all edges.

The fabric will now conform perfectly to the curve and will cover all edges and one side of the frame. The same procedure should be followed in covering the other side of the panel. This will leave one thickness of duck on each side of the frame and two thicknesses overlapped on all edges. In applying covering to the second side, do not stretch the material quite as tightly, because the frame is already under heavy stress and too much additional strain may cause a sag in the material on the opposite side.



The brass top ornament and its base (Fig. 5) and the binding for the hinge edges (Fig. 6).

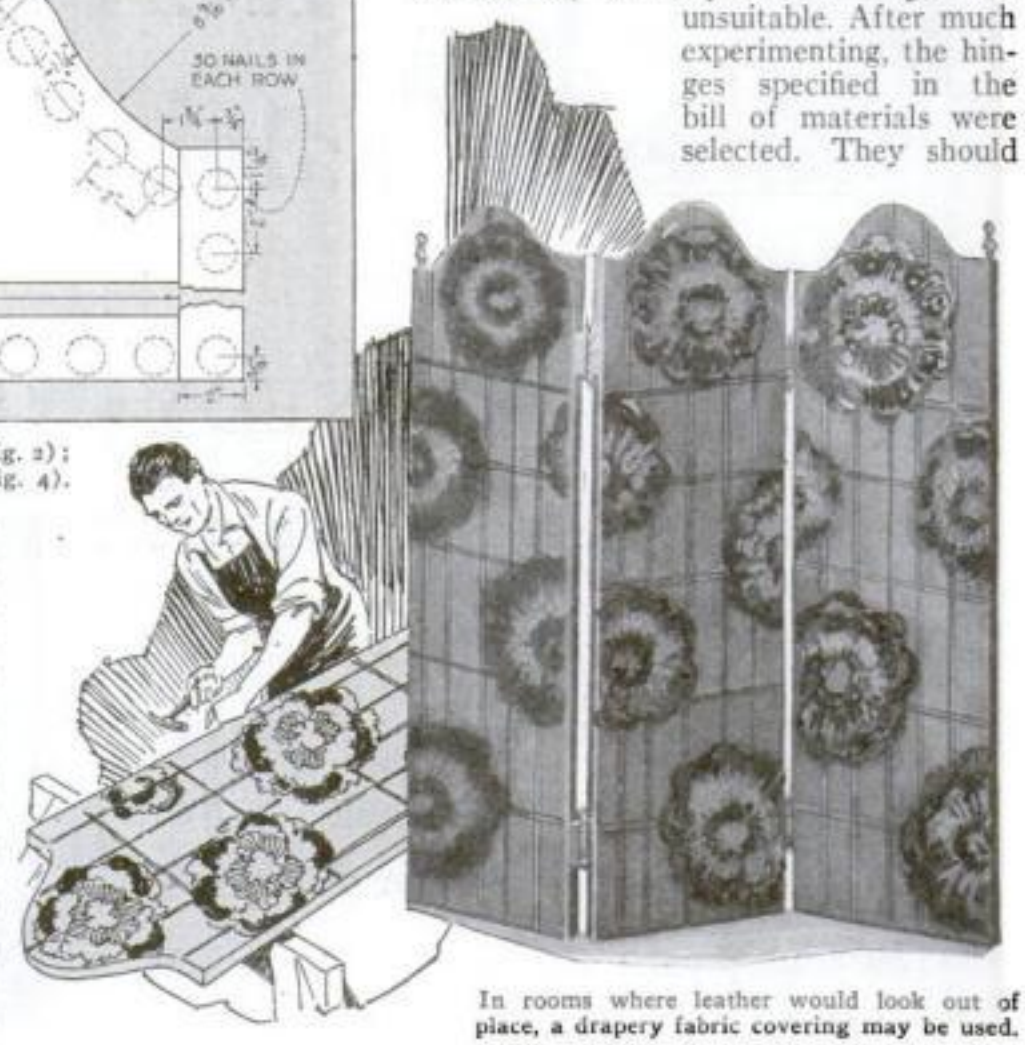
The leather or other outside covering is applied in the same manner as the duck except that it should not be stretched as tightly. Indeed, much care must be exercised not to stretch it so tightly at one point as to cause a permanent "set." The knack of pulling it just tightly enough is acquired after a few minutes' experience.

Leather varies greatly in quality and price, "top grain" being best. At least two matched hides are required, about 100 sq. ft. altogether. Being a natural and irregular product, leather cannot be cut without a certain amount of waste, but the pieces left over may be utilized for making fire screens, picture frames, chair covers, and the like.

Cheaper material such as a "split" (taken from under the top grain) or imitation leather may be used. Top grain, however, is not only inherently beautiful because of its iridescent sheen, but it also is of practically everlasting durability.

The upholstery nail spacing is charted in Fig. 4. On the back of the screen the inside vertical rows are omitted. If a fabric covering is used, the nails should be chosen to harmonize in color and need be applied only on the edges.

Because of the massive proportions of the screen, ordinary screen hinges are unsuitable. After much experimenting, the hinges specified in the bill of materials were selected. They should



In rooms where leather would look out of place, a drapery fabric covering may be used.

be set 7 in. from the upper and lower ends of the uprights. They are fastened over the leather but not over the brass binding (see Fig. 6), which terminates at the hinges. This binding for adjacent edges of the panels is polished with fine steel wool and lacquered before being applied.

Two furniture glides are driven into the bottom of each panel to form feet.

The two ornaments (Fig. 5) may be turned or purchased in spun brass; and a banner is hung across the center.

IMPROVED HORSESHOE PITCHING COURT

PITCHING horseshoes is a game that maintains its popularity, but it can be played later in the year and is more fun if the pitching court is properly prepared so that it never becomes muddy and unsightly. Such a court can be laid out with the following materials: Two old axles from a small auto for pegs, odds and ends of lumber for forms, twenty pounds of cement, and sufficient sand to mix concrete.

Set the axles firmly in the earth 40 ft. apart and at the slant and height required by the rules. Then build a boxlike form 6 ft. square around each of them to hold the cement foundation; for this purpose 2 by 4 in. timbers stood on edge are excellent. Have the protruding ends of the axles in the center of the form and 10 in. higher, each slanting towards the opposite peg.

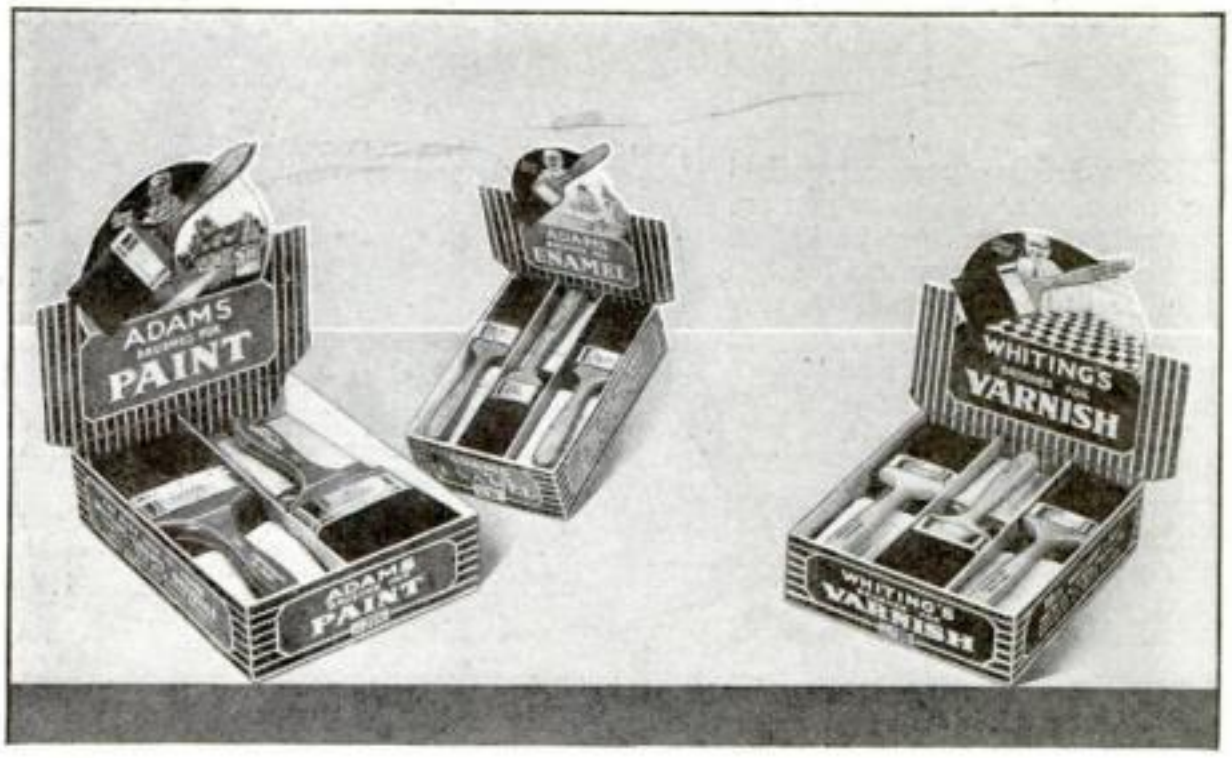
Fill the form with concrete to within 2 in. of the top, and over this spread a layer of sand. Grade the sand gently from the peg to the edge of the form and down to the earth outside. Then, if the sand is wet before a game is played, the surface will be moist enough to keep the shoes from slipping about.

Make a light board cover to fit over each form, boring a hole in the center for the peg, and fasten it in place with hooks. This is a protection against the depredations of dogs and children. Paint the cover a grass green and the pegs white. Obtain at least three sets of pitching horseshoes and paint each a different color.—M. E. CRUMB.

NEWS FOR MEN WHO PAINT AT HOME

CORRECT

brushes for paint, varnish and enamel, now identified by new Whiting-Adams method, help you secure expert results on every job. Send for free booklet, "Painting Hints that Help."



Lack of knowledge of two important factors has limited the results of every man who paints at home. First, the necessity of using a good brush on every job. Some have learned this through sad experience. Some were lucky enough to choose a Whiting-Adams brush at the beginning. Others are still wondering why their work is streaky, splotched and uneven.

Second, the necessity of using the right brush for each job. Few men outside the paint field ever learn enough about brushes to make a perfect selection. Sometimes they have accepted the recommendation of an experienced dealer. Sometimes, with a little knowledge of brushes, they have happened to pick the one best suited to their needs. But more often the brush purchased was a type designed to do some other kind of work.

You can forget these worries now. Whiting-Adams has developed a way to help you secure expert results. The fine quality of Whiting-Adams brushes is nothing new—it has been recognized for 122 years.

But a positive method of identification is new and that is what is offered you with the plain marking of paint brushes, varnish brushes and enamel brushes.

Assure yourself of a good brush for all jobs and the right brush for each job by choosing a Whiting-Adams brush from one of the new identifying display boxes. You will find them at good paint and hardware stores.

WHITING ADAMS SINCE 1808 FINE BRUSHES

WHITING-ADAMS COMPANY

700 HARRISON AVENUE, BOSTON, MASSACHUSETTS

Send for this helpful FREE booklet. "Painting Hints That Help" lives up to its title. You will find yourself turning out better work, achieving finer results on all kinds of paint jobs after you get this free booklet. There's no obligation. Just use the coupon.

WHITING-ADAMS CO.
700 Harrison Ave., Boston, Mass.

Please send me a copy of that free booklet, "Painting Hints that Help."

Name_____
Street_____
City_____ State_____
Name of dealer_____

Kinks to Help Auto Mechanics

Novel way of getting clear when blocked by parked cars—How to install neon stop light on any car

WHEN you leave your car parked at the curb and if while you are absent other cars are parked in front and behind yours, you are blocked in if the other cars are locked. A way out is illustrated in Fig. 1. Put your jack under the center of the front axle and work the jack as high as it will go. Then push the car sidewise until it falls off the jack. This will move the front of the car quite a distance out into the street. Repeat the process till you can drive away.

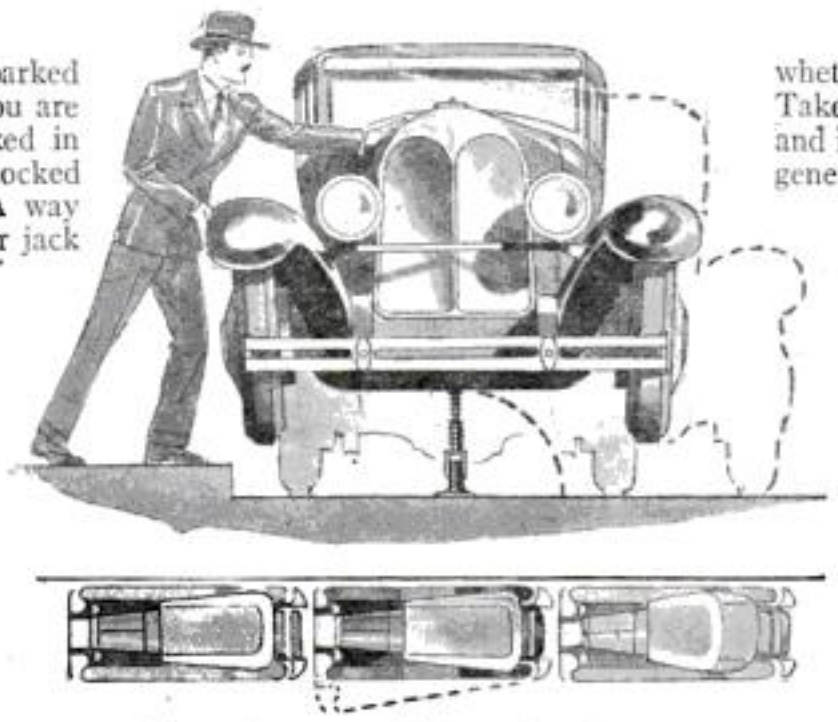


Fig. 1. Shows how a jack can be used to get a car out of a tight place when blocked by autos.

NOVEL CARBON SCRAPER

FIGURE 2 shows how to make a carbon scraper that will cut into and quickly remove the hardest carbon deposit in the cylinder head

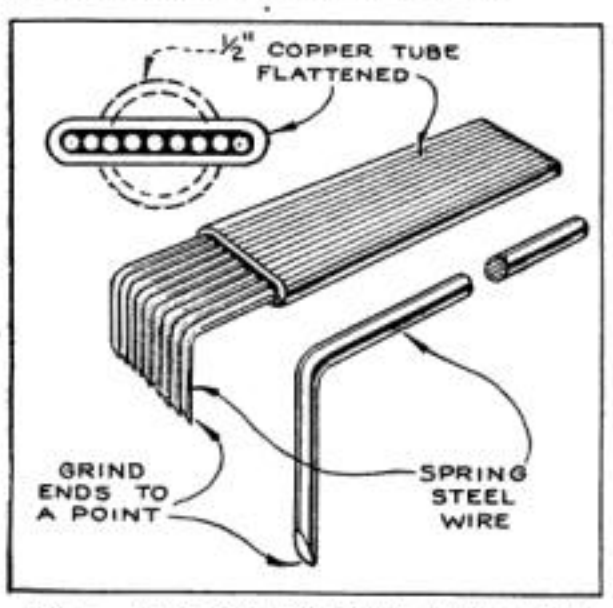


Fig. 2. This tool will scrape away carbon.

or on the pistons. Take a number of pieces of spring steel wire such as piano wire. Cut them to a uniform length. Next, take a piece of copper tubing with an inside diameter of about a half inch and partly flatten it.

Place the wires side by side in the end of the partly flattened tube and hammer the tube till it grips the wires. Bend the ends of the wires down as shown and grind them to a cutting edge. Then stone off the cutting edges a trifle, enough so that they won't bite into the metal. The flexibility of the spring wire makes this tool ideal for scraping carbon from curved surfaces.

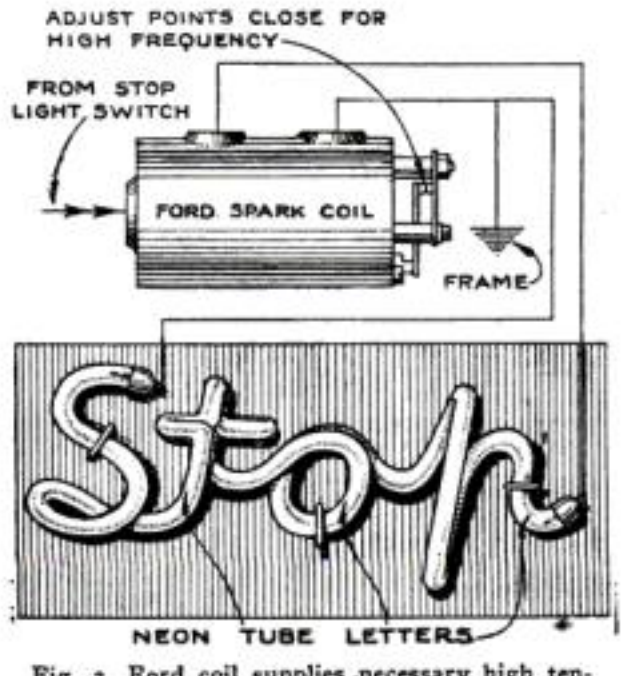


Fig. 3. Ford coil supplies necessary high tension current to operate a red neon stop light.

NEON STOP LIGHT

FIGURE 3 shows a stop light that certainly can be seen. This stop light spells out the word "stop" in the brilliant red of the neon sign. An old Ford coil supplies the necessary high tension current. It should be mounted close to the sign and wired as indicated. No changes need be made in the stop light switch. Simply connect the wire from the stop light switch to the coil. Adjust the vibrator to give as high a note as possible.

GENERATOR TEST

IT IS easy enough to test the windings of a generator to make sure that there are no open circuits. A flashlight bulb connected to the generator will determine whether or not the generator is all right. Take a long nail or a piece of heavy wire and insert it in the lathe center of shaft in generator. Then with a hand drill set over the nail or wire, turn the generator, to which the flashlight bulb has been wired. If the light shines steadily the generator is working satisfactorily, but if the light flickers it is a sign that there is trouble either in the commutator or in the wires.

POPULAR SCIENCE MONTHLY awards each month a prize of $10. in addition to regular space rates, for the best idea sent in for motorists. This month's prize goes to Lemuel Harris, Nogales, Arizona (Figure 5). Contributions are requested from auto mechanics.

VALVE LOCKS

IT IS difficult to install, with the fingers alone, split, tapered valve locks of the kind now used on many cars. To save your nerves and your time, take a piece of thin sheet-iron or tin, snip the ends,

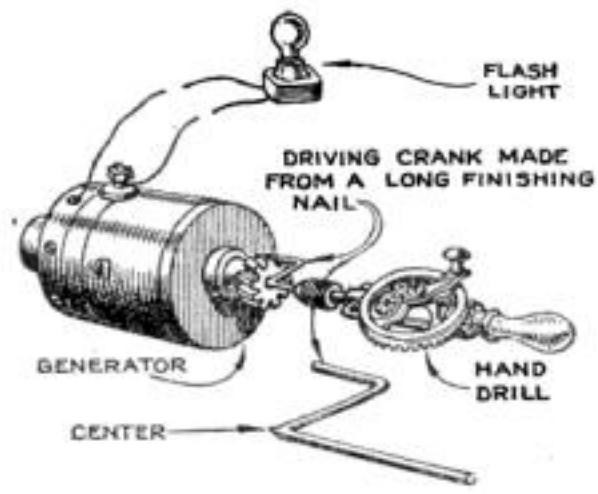


Fig. 4. Simple means of testing a car's generator.

and bend them, as shown in diagram, to fit the valve lock. Place cup grease on the inner surface of the valve so that it will stick in place while the valve spring is being released. The valve locks can be installed easily with this simple tool.

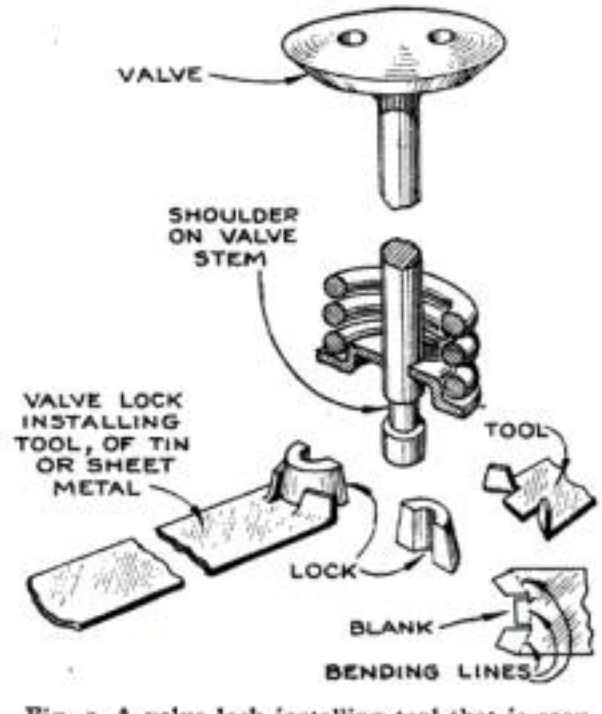


Fig. 5. A valve lock installing tool that is easy to make and will save much wear and tear.

Not taken for granted...

taken apart!

2000 tests a day made in the Mobiloil laboratories—to insure quality

In the making of Mobiloil for your car, your engine is not taken for granted. It is taken *apart*. Its lubrication needs are studied.

Each run of finished Mobiloil is also "taken apart." The 2000 tests insure its quality and its correctness for your engine.

These tests guard your engine

For example: In the Mobiloil laboratories you come on a group of white-coated chemists watching the slow revolutions of an intricate machine. This machine measures the ability of an oil to resist gumming and oxidation.

Or you'll notice another group. They are intently observing oils simmering in little copper dishes. At intervals they pass tapers over the oils to find the temperature at which they ignite. This tells them how well each oil will resist heat. They later burn the oil to determine the amount and the kind of carbon it leaves.

Then you'll see other men working with delicate instruments that determine the strength of the film formed by an oil on metal surfaces. This indicates the ability of the oil to keep down wear in the moving parts of your engine.

And so on with group after group—each plays its part in the complete testing of Mobiloil quality.

Where else can you find such protection?

Sometimes oil-making does not go much beyond the crude oil well. That's why you hear so much talk about "crudes." In making Mobiloil, the strict control of quality follows each refining step until the finished oil is ready for your engine.

Where else will you find such complete recognition of your engine's needs? Such certainty that they are fully met—that your engine will be fully protected?

Your Mobiloil dealer has the Mobiloil Chart which shows the grade of Mobiloil recommended for your engine.

VACUUM OIL COMPANY

Motor oil is *made* . . . not *found!*

Mobiloil

Ask here for GARGOYLE Mobiloil

Make this Chart your Guide

This abbreviated chart shows the correct grade of Gargoyle Mobiloil for most passenger cars. You will find the complete, Mobiloil Chart at your Mobiloil dealer's.

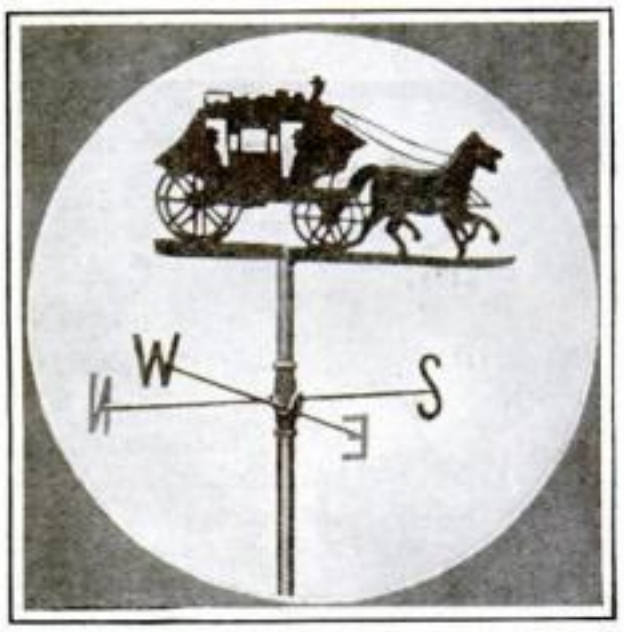
Follow winter recommendations when temperatures from 32° F. (freezing) to 0° F. (zero) prevail. Below zero use Gargoyle Mobiloil Arctic (except Ford, Model T, use Gargoyle Mobiloil "E").

NAMES OF PASSENGER CARS	1930 Engine		1929 Engine		1928 Engine		1927 Engine	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Auburn 6-85	AF	Arc.	....	....	....	....	....	....
" 6-66A, 6-80, 76	....	....	A	Arc.	A	Arc.	A	Arc.
" other models	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Black Hawk	BB	Arc.	BB	Arc.	....	....	....	....
Buick	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Cadillac	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Chandler	....	....	A	Arc.	A	Arc.	A	Arc.
Chevrolet	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Chrysler 70, 77	BB	Arc.	....	....	....	....	A	Arc.
" Imperial	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
" other models	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
De Soto	AF	Arc.	AF	Arc.	....	....	....	....
Dodge Bros.	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
Durant 614	AF	Arc.	....	....	....	....	....	....
" other models	A	Arc.	A	Arc.	A	Arc.	....	....
Elcar 6-70, 75	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" other models	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Erskine	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Essex	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
Ford Model A	AF	Arc.	AF	Arc.	AF	Arc.	....	....
" Model T	....	....	....	....	....	....	E	E
Franklin	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Gardner 6-cyl. 136	AF	Arc.	....	....	....	....	....	....
" 8-cyl.	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Graham and Graham-Paige	BB	Arc.	BB	Arc.	BB	Arc.	....	....
Hudson	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
Hupmobile	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
LaSalle	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Lincoln	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Marmon Big 8, 75, 8-79	BB	Arc.	....	....	BB	Arc.	BB	Arc.
" other models	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
Nash-Twin Ig. 8, 490, Adv.6, Sp.6, Twin Ig.6	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Nash (other models)	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
Oakland	BB	Arc.	A	Arc.	A	Arc.	A	Arc.
Oldsmobile	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Packard	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Peerless 61, 81	....	....	AF	Arc.	....	....	....	....
" 60, 69, 80	....	....	....	....	A	Arc.	A	Arc.
" other models	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Pierce-Arrow	BB	Arc.	BB	Arc.	A	Arc.	A	Arc.
Plymouth	A	Arc.	A	Arc.	....	....	....	....
Pontiac	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Reo (all models)	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
Studebaker Com'der 8	AF	Arc.	AF	Arc.	....	....	....	....
" President 8	BB	Arc.	BB	Arc.	BB	Arc.	....	....
" other models	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Stutz	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Whippet	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Willys-Knight	A	Arc.	A	Arc.	BB	Arc.	BB	Arc.
Windsor 6-70, 6-72, 6-75	AF	Arc.	AF	Arc.	....	....	....	....
" other models	BB	Arc.	BB	Arc.	....	....	....	....

How to make stagecoach and covered wagon

Weather Vanes

By J. W. BOLLINGER



Galloping in the wind, this Concord stagecoach is a most decorative weather vane. Easy to make, too.

FROM a decorative and artistic standpoint, weather vanes are becoming more and more popular. In fact, a well-designed and properly placed weather vane gives an added note of charm and character to any house.

The present interest in making models of stagecoaches and covered wagons has led to the development of weather vanes based on the same decorative elements, and both are excellent. The stagecoach silhouette suggests a fast-moving vehicle on a pleasant summer day, whereas the covered wagon conveys the idea of slow, determined plodding, without, however, losing the effect of forward movement.

A good weather vane must meet at least three essential requirements: it must be substantially made, must show directions as accurately as possible, and must permit the design to swing freely with the wind.

Manufactured weather vanes, to withstand corrosion by the elements, are made of copper, brass, or aluminum, and if possible the amateur should use one of these materials. However, since they are expensive and sometimes hard to obtain, it was thought best to make the vanes illustrated of iron to show what can be done with the cheaper metal. Several coats of paint or lacquer will insure the durability of the iron for many years.

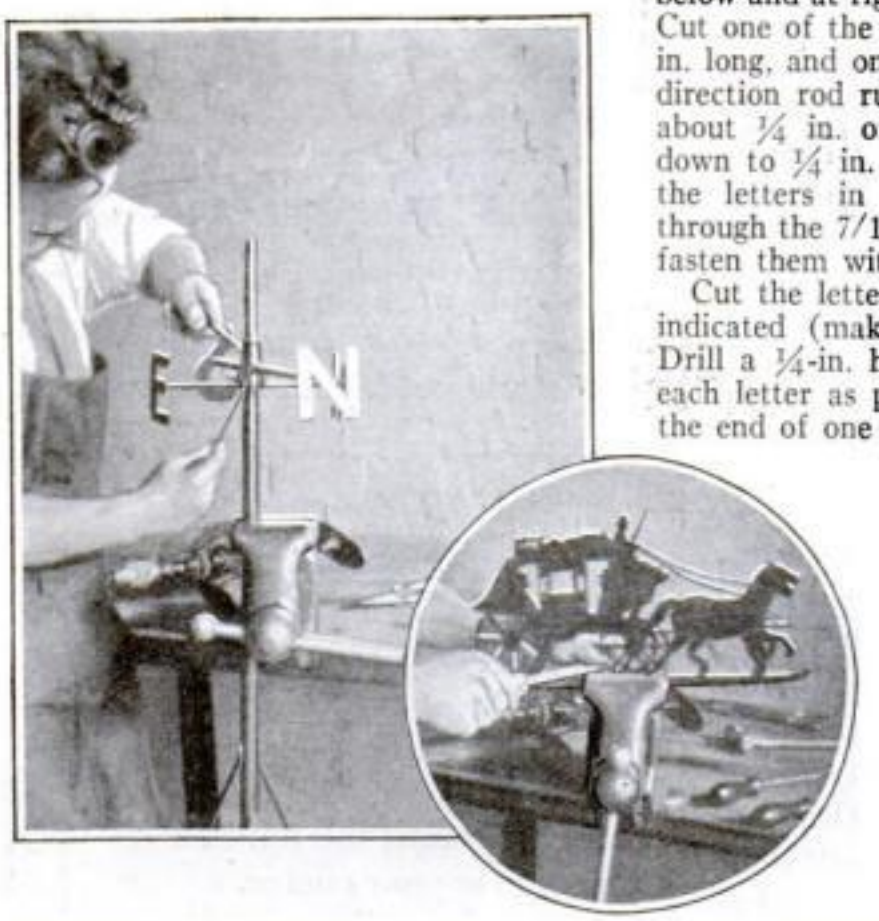
To make a weather vane of the type shown, get two pieces of ½-in. pipe, each 2 feet long; a piece of ⅜-in. pipe, 6 in. long; a ½-in. pipe sleeve, and a ½ to ⅜ in. pipe reducer. You will need also about 3 ft. of some 7/16-in. round iron, a sheet of No. 20 gage galvanized iron 10 by 18 in., and about 25 ft. of No. 12 galvanized iron wire.

MAKE a full size drawing of the selected design on a sheet of wrapping paper, using the 2-in. squares as guide lines. Cut around the outside of the design to make a paper pattern, but do not cut any holes in the paper; then trace the outline accurately on the metal.

Use tin shears, cold chisel, hack saw, jeweler's saw, metal drill, grinder, and a set of files for doing the cutting. To keep the metal from bending, clamp it in the vise between two boards.

After you have shaped the outside, put a piece of carbon paper between the metal and your pattern, and trace the openings. To cut these out, drill a series of holes inside the line, chisel out the waste, and file to shape. The coachman's lines and the whips are made of No. 12 galvanized iron wire soldered in place.

Weather vanes may be placed on either the ridge or the slope of the house or garage, or on a garden trellis or a special pole. Whatever location is selected, cut a suitable wooden base block from a piece of "four by four" and drill a ⅞-in. hole into it to receive one of the 2-ft. pieces of ½-in. pipe. The pipe must fit tightly.

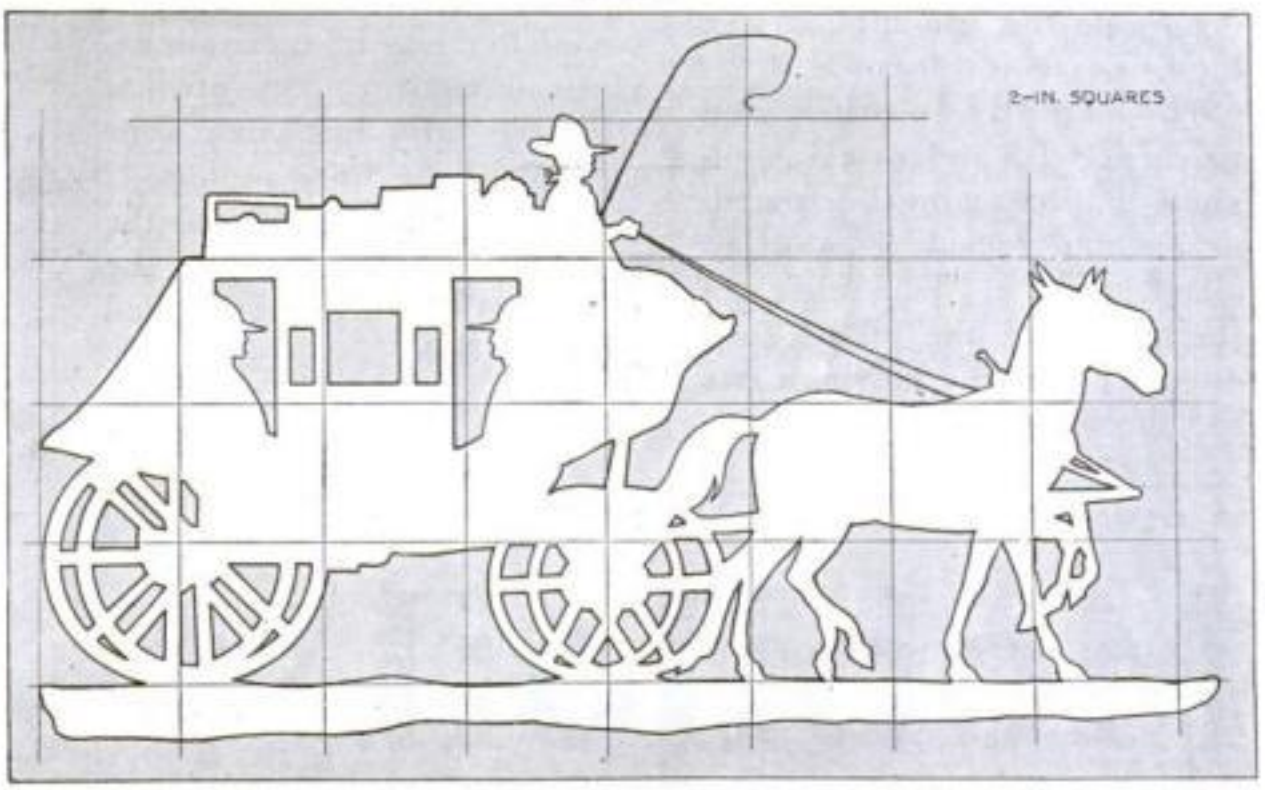


About 18 in. up from the end of this pipe, drill two holes at right angles, one slightly above the other. Run No. 12 wire through these holes to the roof (or other support) so as to brace the pipe and hold it in a vertical position. This is the simplest method, but iron braces may be used, if preferred; the writer used iron braces in the case of the stagecoach weather vane illustrated.

DRILL a 7/16-in. hole through the other piece of ½-in. pipe about 1 in. from what is to be the upper end, and drill another 7/16-in. hole about 1 in. below and at right angles to the first hole. Cut one of the 7/16-in. direction rods 16 in. long, and one 10 in. long. The longer direction rod runs north and south. File about ¼ in. of each end of each piece down to ¼ in. in diameter for fastening the letters in place. Slip these pieces through the 7/16-in. holes in the pipe and fasten them with No. 12 wire, as shown.

Cut the letters E, W, N, S to the size indicated (making the W a bit wider). Drill a ¼-in. hole as near the center of each letter as possible, slip a letter over the end of one of the direction rods, and flatten out the projecting end so as to rivet the letter in place.

Screw the pipe reducer on the ½-in. pipe above the direction rods. Get some small pieces of solder and drive them in place right over the direction rods inside the pipe. Make the surface of the solder inside the



To prepare a full size pattern of the stagecoach, lay out a number of 2-in. squares on wrapping paper and copy the outline free-hand by noting the points where it should intersect the squares.

Where to Get Job Plans for . . . 200 Things to Build

is Told in This New ATKINS Book!

Using an ATKINS Silver Steel Coping Saw to cut molding for a coped joint.

Sawing half blind dovetails with an ATKINS Silver Steel Dovetail Saw.

A VALUABLE feature of this new ATKINS Saw Book for Home Craftsmen is a complete "What to Make" section. It lists more than 200 popular articles and tells where you may readily obtain blue prints or job plans and instructions to build the projects you select.

Whether you are interested in building coach, ship or plane models, radios, boats, toys, novelties, or home and garden furniture, you'll find this handy reference list the most complete one of its kind, and a "gold mine" of ideas for home shop projects.

Consult this list before you decide on the things you want to build this fall and winter; and save time, work and money by getting reliable plans. Check over the ATKINS Silver Steel Saw section in the book, and see which of these saws and cutting tools you need. Your Hardware Dealer has them!

Better mail a dime today, to get your copy promptly. The first edition is going fast; clip the coupon NOW!

. . Also, It Tells The Secrets of Making Perfect WOOD JOINTS

NO LONGER need you hesitate about tackling projects where accurate joinery is needed! In this book, a veteran craftsman tells the secrets of making perfect-fitting joints — butt, coped, dado, dovetail, dowel, glued, halved, lap, matched, miter, mortise-tenon, rabbet, splined, and many others.

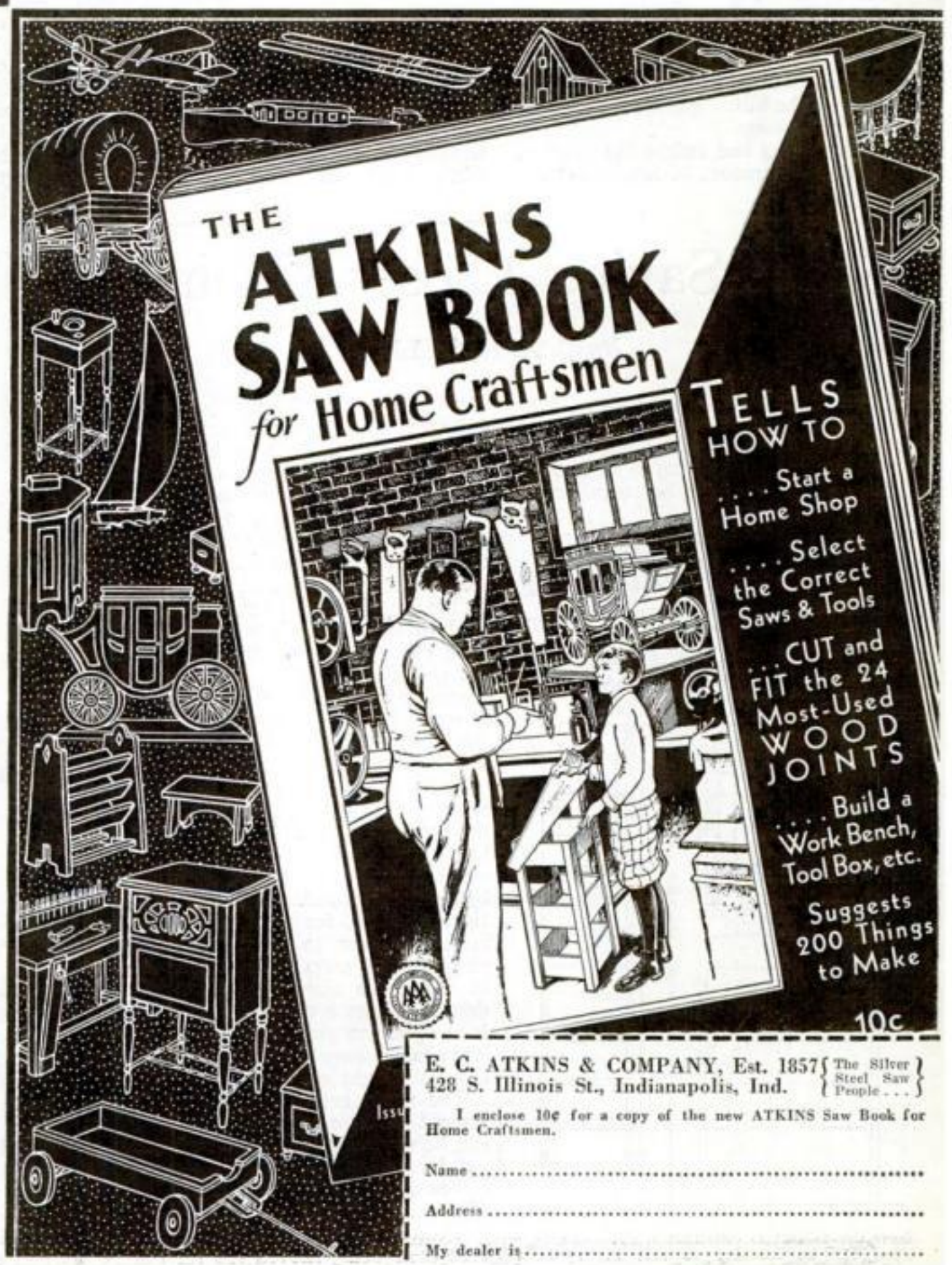
Page after page of easy-to-follow drawings, photos and directions point out the best way to cut and fit these joints. Even if you now do good joinery, the book gives many fine points which will help you make still better joints, quicker and easier.

This section on JOINTS alone is worth many times the price. The complete book is a real workshop manual. It gives advice on starting a new home shop and choosing the right tools . . . tells how to build shop equipment . . . lists over 200 projects and job plans available . . . discusses various types of saws, their uses, and care.

And in the back of the book is a section which shows the leading ATKINS Silver Steel SAWS, and tells why they are the favorite saws with fine mechanics the world over—why they cut faster, run easier, hold a keen edge longer and outlast two or three ordinary saws.

Amateurs find this new book indispensable. Experts say it's mighty helpful! Costs only 10c, but worth dollars to every home craftsman.

Send the Coupon for Your Copy!



E. C. ATKINS & COMPANY, Est. 1857 { The Silver Steel Saw People . . . }
428 S. Illinois St., Indianapolis, Ind.

I enclose 10¢ for a copy of the new ATKINS Saw Book for Home Craftsmen.

Name .....

Address .....

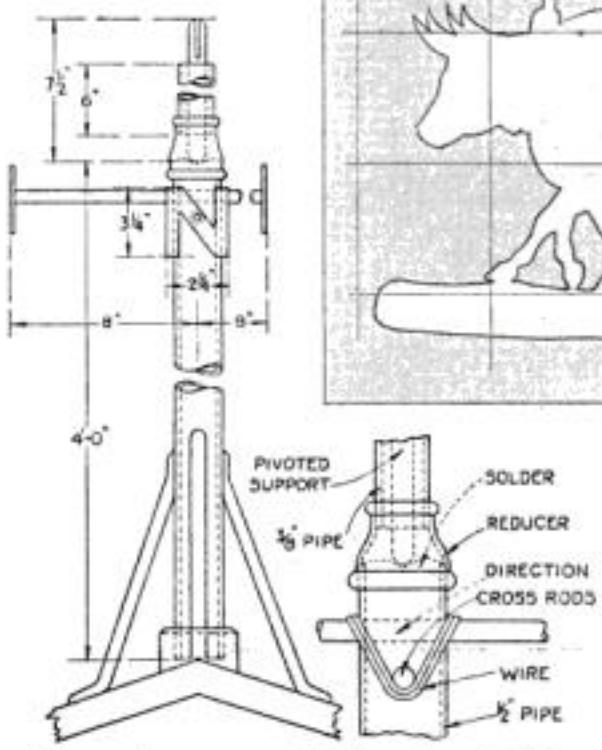
My dealer is .....

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

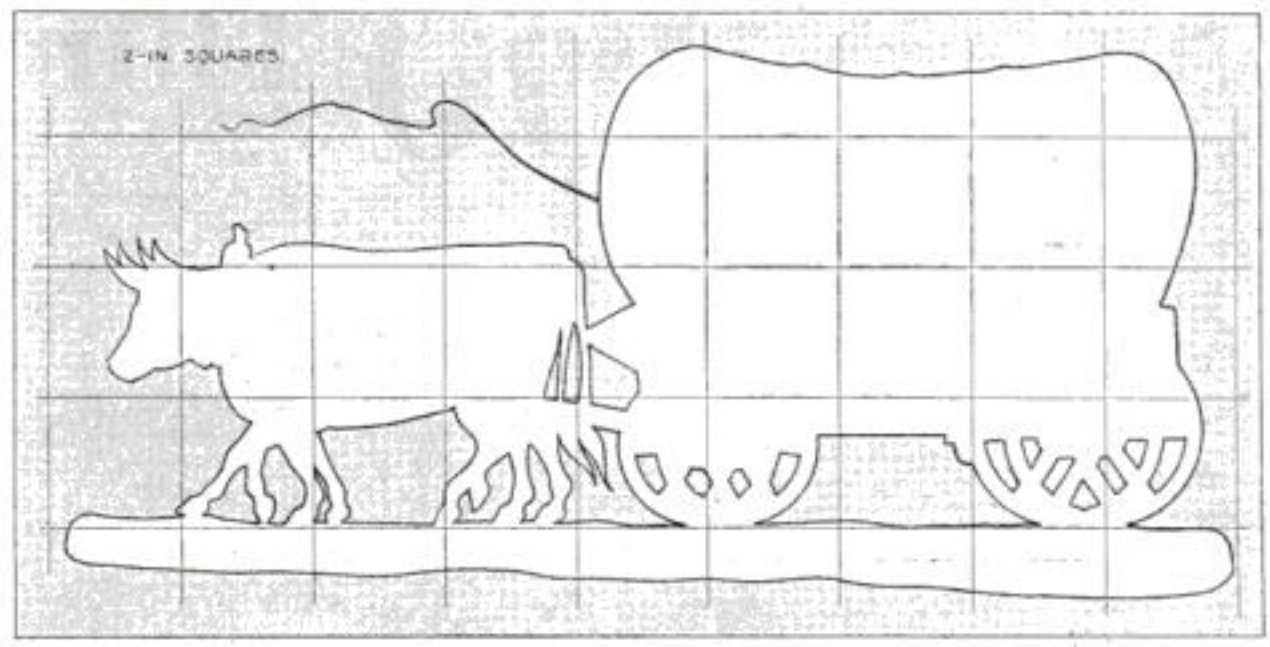
pipe cup shaped to form a suitable bearing for the vane. Then screw the 6-in. length of ⅜-in. pipe into the reducer.

You are now ready to fasten the assembly just made to the pipe already mounted in the block of wood. For this you will need the ½-in. pipe sleeve. Turn the upper pipe until the N points as nearly north as possible. Test the setting with a magnetic compass.

Cut a piece of 7/16-in. round iron 7½ in. long. File one end as nearly hemispherical as possible. With a hack saw cut a slot ¾ in. long in the other end. This rod fits inside the ⅜-in. pipe and pivots on the cup shaped surface of the solder. For a better job, get a steel ball (or marble) to ride on the solder, and let the rod pivot on the ball. To keep this assembly from rusting and reduce the friction, put in a small amount of lubricating oil.



The weather-vane standard and a detail showing how the direction rods are fastened.



If you prefer to make the covered wagon, which is simpler than the coach, start by drawing a full size pattern with the aid of the 2-in. squares.

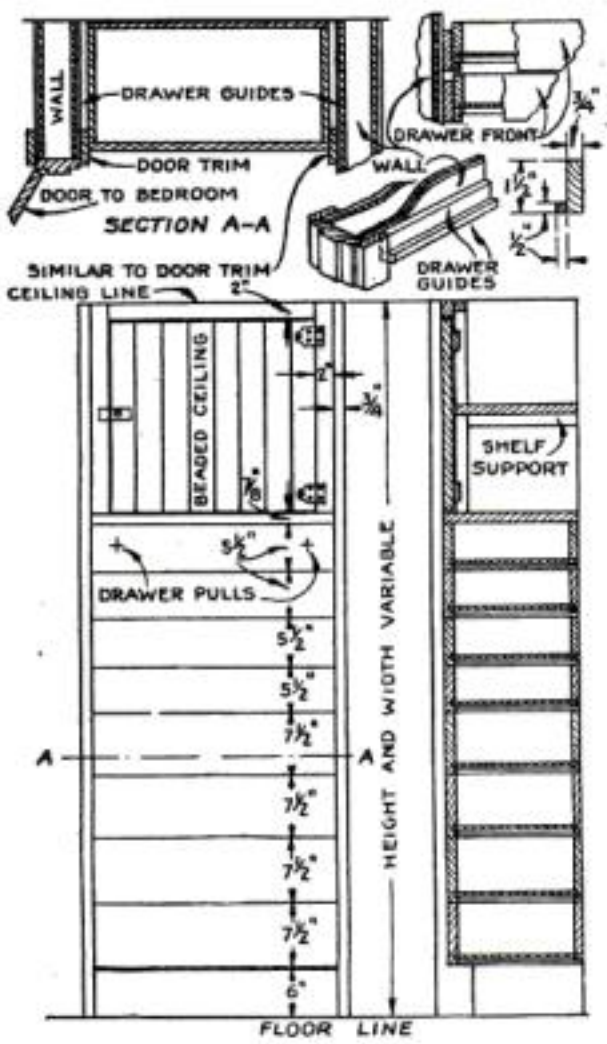
The silhouette design is slipped into the slot cut into the 7/16-in. rod and either riveted in place with ⅛-in. rivets (or nails) or soldered. In order that the coach (or wagon) will always be going in the direction of the wind, that is down wind, the figure must be pivoted out of center, so that the longest end is the forward end. A point between the front and rear wheels, and nearer the front wheels, will be found best. A little solder melted on the rear end of the vane will make it balance better and swing more readily. It is, of course, necessary that the ⅜-in. pipe be as nearly vertical as possible.

Give the completed weather vane two or three coats of flat black paint or black lacquer.

Space-Saving Closet Cabinet

By C. A. ROSELL

HAVE you ever wished for more drawer space in a bedroom that was too small to accommodate another piece of furniture? One solution is to build a shallow cabinet into the bedroom closet. It will be out of the way yet almost as handy as if it were in the room. You must, of course, sacrifice a little closet space, but the advantage of the cabinet by far overshadows this loss.



How the cabinet is constructed. The dimensions can be modified to suit the space.

In most closets there is a space between the door and the side wall that can be utilized for such a cabinet. The usual closet is not so large that a drawer would be too long if made to run from front to back of the closet, therefore the framing need be only ¾ in. thick strips such as are used for door trim. To conserve the space above the drawers to advantage fit one above the other without any framing between. This also simplifies the construction and reduces its cost.

The floor-to-ceiling height will determine the amount of storage space above the drawers. If there happens to be full-height ceilings in your closets, utilize the space above the drawers to advantage by inclosing it as shown. Do not add additional drawers, for they will be too high from the floor to look into easily. If necessary, an extra shelf may be inserted in the space above the drawers. The drawing shows a ceiling height of only 7 ft., so you can see that much more space is available above the drawers where there is a full-height ceiling.

The space below the drawers is convenient because several pairs of shoes can be slipped into it. A narrow strip of wood may be nailed to the floor a few inches closer to the wall than the front of the drawers and parallel to them; this will catch the heels of the shoes and prevent their being shoved too far back.

The cabinet is built into the closet in the space between the door and the side wall.

The form of drawer construction illustrated is very simple and has the advantage of giving a maximum of space. If you choose, however, you may use another type of drawer. The guides should be made in pairs in case there happens to be a difference in the way they must be fitted into the space available. Glue and nail the small strips to the larger ones so they will not come loose.

The cabinet will look best if stained and varnished or painted to match the trim and other woodwork about the room.

"Five days to drive the car you buy —*then decide!*"

THIS is the way the famous Studebaker Pledge protects your purchase. You *drive* the car you buy. If for any reason, it does not measure up to your expectations, you may return it within five days and apply your payment on any car in your Studebaker dealer's stock, new or used!

Besides this five days' driving trial, the Studebaker Pledge provides a 30-day guarantee on all Certified cars and states explicitly that *every* Pledge-backed car must have its lowest price plainly marked.

These assurances were important factors to the buyers of hundreds of thousands of used cars from Studebaker dealers. People who *look* before they buy used cars recognize the Studebaker Pledge as fair, square sales policy. When you buy your used car, see your Studebaker dealer first—get the full protection of the famous Studebaker Pledge!

Pledge to the Public on Used Car Sales

1 Every used car is conspicuously marked with its lowest price in plain figures, and that price, just as the price of our new cars, is rigidly maintained.

2 All Studebaker automobiles which are sold as CERTIFIED CARS have been properly reconditioned, and carry a 30-day guarantee for replacement of defective parts and free service on adjustments.

3 Every purchaser of a used car may drive it for five days, and then, if not satisfied for any reason, turn it back and apply the money paid as a credit on the purchase of any other car in stock—new or used. (It is assumed that the car has not been damaged in the meantime.)

Invest 2c . . . You May Save $200

Spend 2c now for your copy of this interesting and instructive booklet, "How to Judge a Used Car"—it may save you as much as $200 on the used car you buy. Mail the coupon now!

THE STUDEBAKER CORPORATION OF AMERICA
Div. 1611, South Bend, Indiana

Please send me copy of "How to Judge a Used Car."

Name.....

Street.....

City..... *State*.....

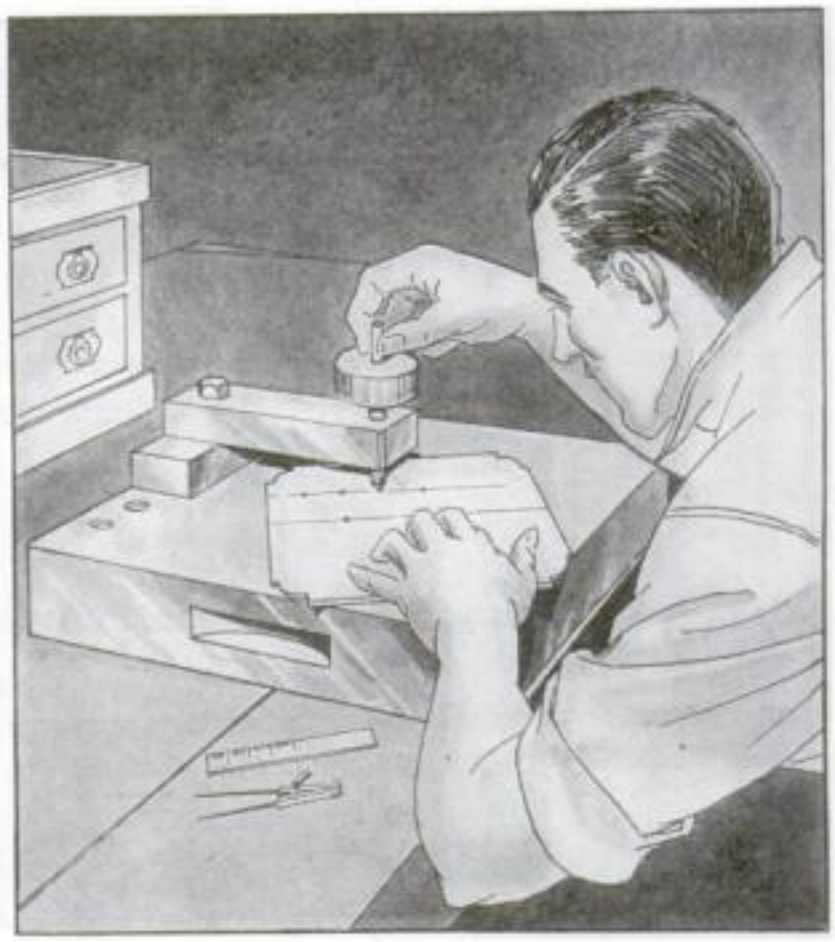
Studebaker

Builder of Champions

New Ways to Use Old Tools

Making reamers cut oversize—Using taps for force fits—Hints on center drills—How to improve surface blocks

By HENRY SIMON



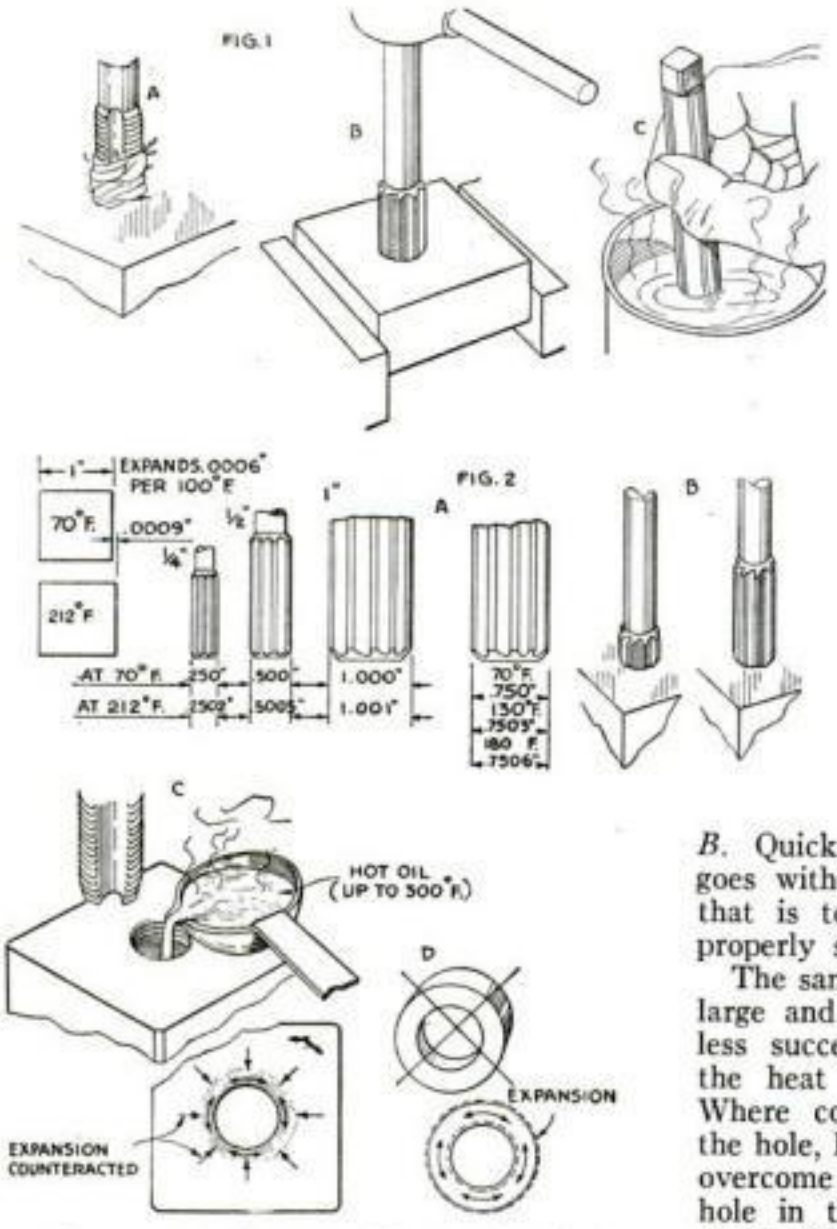
Producing accurate centers in delicate work with a special center drill made as in Fig. 4. The tool is twirled by hand.

ONE of the biggest questions in the all-around machine shop is how to reconcile economy with up-to-dateness. The kind of economy that is content to get along on worn-out micrometers and "lead" drills is the worst kind of waste, but there is a real economy that consists in making the most out of the equipment on hand—the economy that finds new jobs for old tools and unexpected ways of extending their range of work.

For instance, there is that way of increasing the size of a reamer with a pint of soda water! The fact is, this method is much better than the time-honored trick of making a tap cut oversize by wrapping it with waste, as at *A* in Fig. 1. The same thing can be done with a reamer by plugging some of the flutes on one side. The theory—and also the fact—about this method is that a few of the waste strands will roll up in some of the flutes, thereby causing the remaining opposite edges to be forced deeper into the metal.

This expedient is one of the dear old "rough and ready" machinists' kinks that has saved the day in many a pinch—and ruined as many good jobs. How much more satisfactory it is to immerse the reamer in hot soda solution—the soda being added to keep the tool from rusting—just before using it as indicated at *B* and *C*. You increase its size in a very exact and wholly scientific way, and make it cut oversize in an entirely workmanlike manner.

Don't be afraid of hurting the cutting edges by the hot water, in spite of all fairy tales to the contrary. Putting a reamer or any other tool in boiling water for a minute or two will not damage the temper, even if it is repeated many times.



Reaming a hole oversize (Fig. 1); how heat expands a reamer, and other hints (Fig. 2).

FIGURE 2 at *A* shows that a very noticeable expansion can be produced this way, and how the same reamer can be expanded to different sizes with the help of a thermometer. With boiling water, the expansion is about .001 in. per inch of diameter. An allowance must be made for the cooling that takes place through contact with the cold work. Reamers down to ¼ in. may be made to cut oversize in this manner.

It is usually advisable first to ream the hole with the reamer cold, and then with it hot, as suggested at *B*. Quick action is necessary, and it goes without saying that any reamer that is to take a fine cut must be properly sharpened.

The same method may be used with large and accurate taps, though it is less successful, because taps radiate the heat to the metal too rapidly. Where considerable metal is around the hole, however, this trouble may be overcome by pouring hot oil into the hole in the cold metal and then at once using the hot tap, as shown at *C*. With a fairly thin-walled part like that at *D*, on the other hand, the very reverse would be accomplished by the hot oil, as there is no surrounding cold metal to counteract the expansion.

As long as we are on the subject of taps, let me mention one excellent use for them that is rarely turned to account. This is illustrated in Fig. 3 and concerns the use of a tap as a relieving tool. Drive fits that cannot be driven can be made to "toe the mark" by the simple procedure of tapping the hole before finish-reaming it. By using a tap that is a little "under," the contact surface for the fit can be made practically anything between about one eighth and seven eighths of full, as demonstrated at *B*. The clearance absorbs the excess expansion and the displaced metal, as shown exaggerated at *C*.

Tapped force fits give a more uniform grip and cause less strain in the work than plain fits. They are cheap to make, and can be applied anywhere. On the other hand, a tap may be employed for producing a clearance or oil space for a sliding part, as at *D*. In this capacity, it has the advantage over the usual way of relieving in that it may be applied to heavy parts difficult to handle on a machine. How the ends can be closed up by soldering to keep oil from leaking out, is illustrated at *E*.

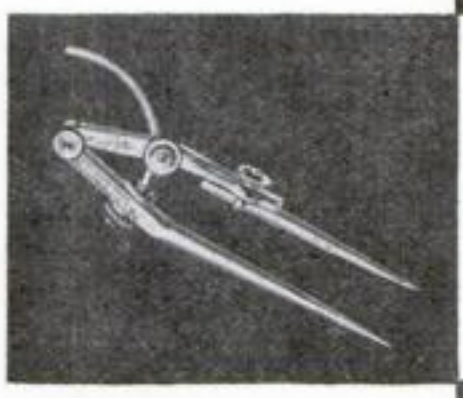
BEFORE we leave the cutting tools—what is the quickest way of making an accurate center drill? The answer to that question is: From a center punch. Figure 4 at *A* shows the simple way in which it it done by grinding off one half the point. Such a center drill is not for rough or large work, and it cannot be reground as conveniently as the two-lipped kind. To make up for that, it can be brought down to a degree of fineness that is out of the question with any other type, although

Builders' Tool

No. 439—handy tool that helps on every job—no bothersome calculations.

Combination Square

No. 94—marking gage, rule, square, miter, depth gage, height gage, level and plumb—all in one.



Dividers

No. 92—rigid, yet light and easy to handle. Quick, positive adjustment.

Steel Tape

No. 530—tough, spring-steel tape—resists kinks—quick-reading markings.

Level

No. 132—a level that stays accurate through years of use—3 protected vials.

Easy Grip Hacksaw

No. 169—the finest hacksaw frame you can buy—saves blades—pistol-grip handle prevents fatigue.

Combination Square

No. 23—a fine combination square fitted with scriber—graduated in 8ths, 16ths, 32nds, 64ths.

Scraper

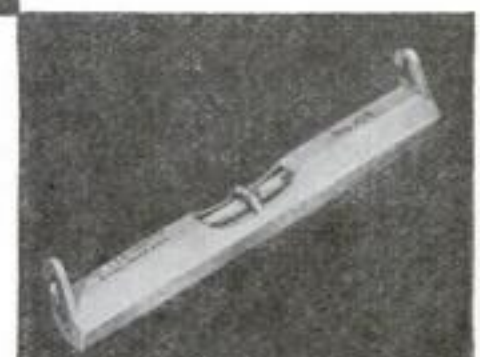
No. 181—blade can be set at any angle, firmly locked by twist of the handle.

Nail Set

No. 800—round grip and large striking surface—five sizes—square head prevents rolling.

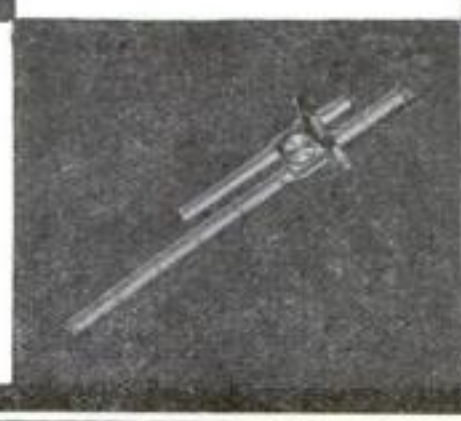
Line Level

No. 108—a line level with graduated vial—weighs only ½ ounce—luminous level glass.



Transit

No. 99—a simple, inexpensive transit that gives accurate results—made for the practical man.



Scratch Gage

No. 429—case-hardened, octagonal head—one 4" plain bar—one 8" bar graduated in 32nds—both fitted with rotating cutters.

STARRETT TOOLS · STARRETT HACK SAWS

Use Starrett Tools ®

SEND FOR FREE BOOK

These fine Starrett Tools are fully described and priced, with many more, in the new Starrett Catalog No. 25 "W". This valuable reference book is free. Send the coupon.

THE L. S. STARRETT CO., Athol, Mass.

Please send me Starrett Catalog No. 25 "W".

Name .....

Address .....

City ..... State .....

4343

Old Bill *Says-*

WHEN driving a dowel pin out or in, use a short, accurately fitting, soft punch. It is less apt to swell the pin.

Better results in cutting small irregular shapes from sheet metal can be had by clamping the tin snips in a bench vise and using it as a shear.

The manufacturers of radius gages found we were poor guessers.

To test work for squareness on a surface plate with a height gage and indicator, hold the indicator stationary if possible and move the part around under it. You will get a truer reading.

An ounce of preparation is worth more than a pound of scrap.

such fine tools should, of course, be turned from the rod on purpose.

By carefully pointing the drill under a magnifying glass and finishing on an Arkansas stone as at *B*, a drill may be produced that will make burrless centers as small as .010 in. in diameter, accurately located on the finest scratch line. In very thin or frail work, this method is often superior to center punching because it develops no strains in the metal.

For very fine marks, the tool cannot be successfully used in a drill press. A good appliance for the purpose is the simple device illustrated at *C*, which is easily rigged up on any surface block. The depth and diameter of the hole is determined by the weight *a*, the tool being twirled by the fingers to get the cutting action.

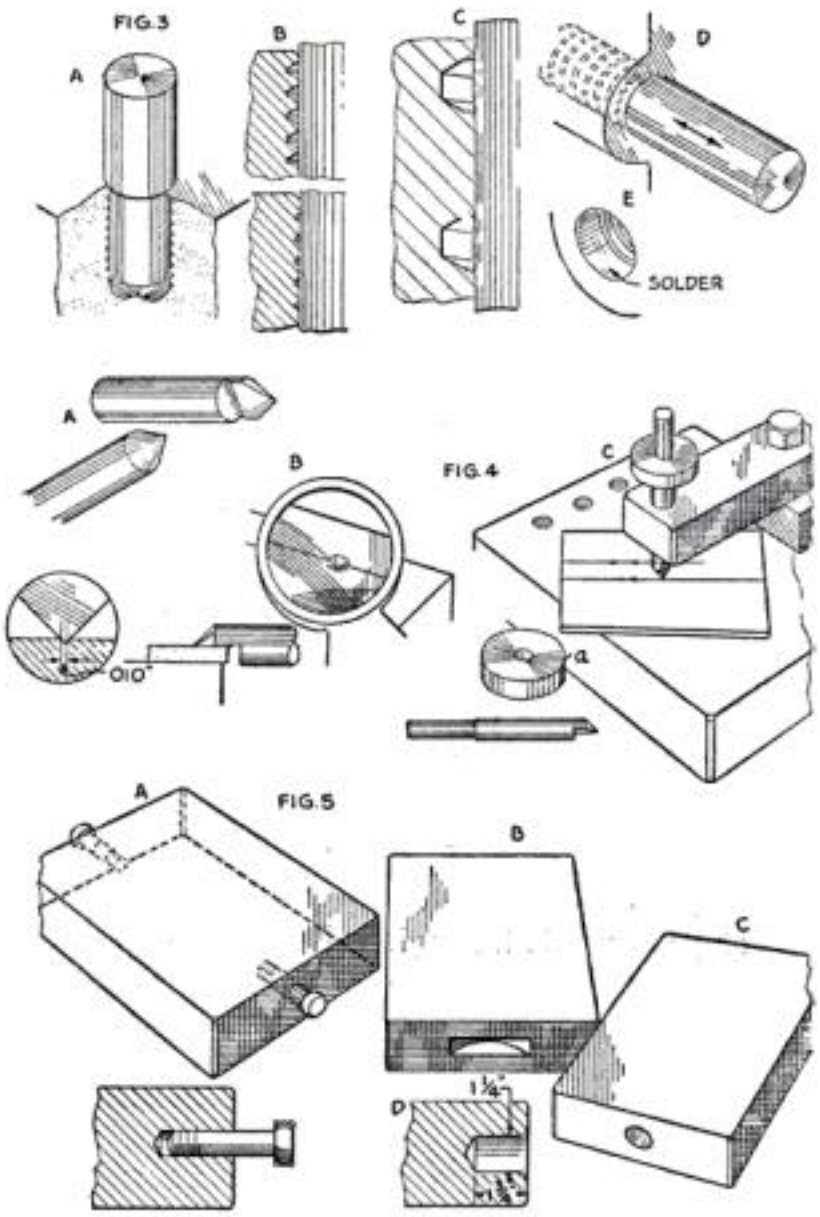
Speaking of surface blocks, there are ways to improve even these plainest of machinists' implements. For instance, by making several tapped holes about 1½ in. from one edge or from two adjacent edges, as in the block shown at *C*. Such holes are handy for attaching temporary appliances, yet are never in the way.

In other respects, however, the block in question is as bad as the common run in that there is no convenient way to move it and turn it over. Figure 5 shows several such means. The knob handles at *A* are easily made from stout cap screws. They are lightly turned home by hand and can be easily removed when desired. Blocks of lesser weight may be made with cast or milled slots as at *B*, which give a firm grip and are never in the way. But for a block of any reasonable weight, the simplest, best, and handiest "handles" are the round finger holes illustrated at *C*, because they are out of the way at all times, yet allow the block to be easily rotated around the index and second fingers of both hands, to bring the "Sunday" side to the top. The holes should be smooth inside and well rounded on the edge, as illustrated in detail at *D*.

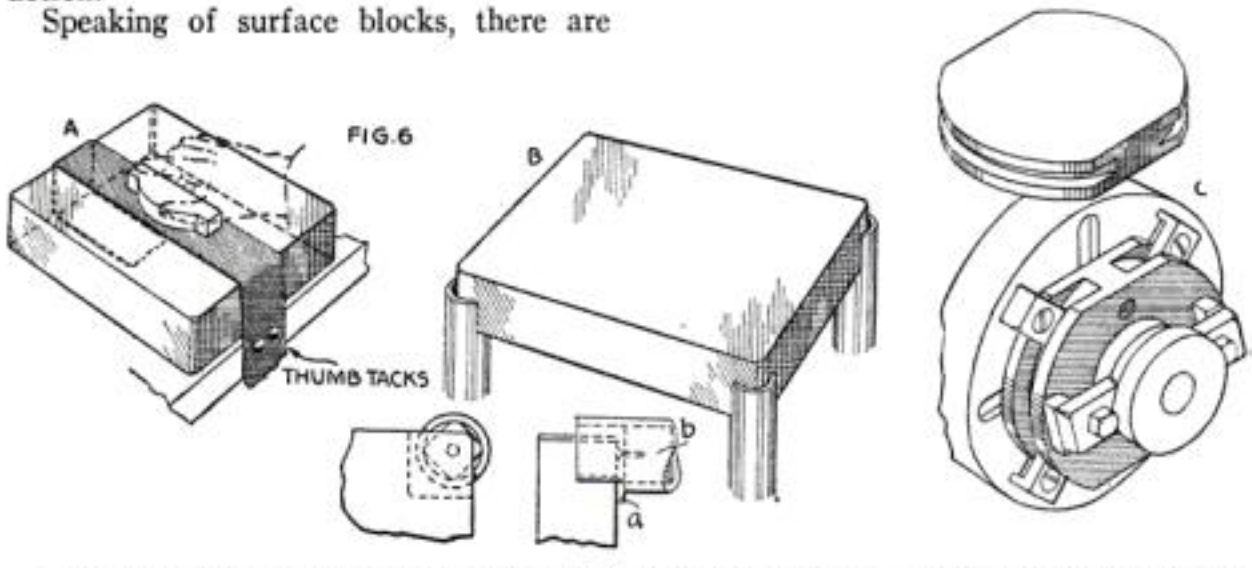
A few other pointers about surface blocks are suggested in Fig. 6. At *A* is shown a block in use as a base for abrasive cloth for finishing flat surfaces on wooden or metal parts. The abrasive strip is put under tension by slightly shoving the block forward.

The drawings at *B* illustrate a rarely seen, but extremely handy arrangement of a large block used as an independent table, with the legs cemented or screwed to the floor. Leather or sheet lead squares *a* tacked to a wooden block *b* may be used in the seats to deaden the blow and prevent rebound.

At *C* is illustrated a lightweight semi-round design of block that is suitable for receiving work that must be reset or floated on the faceplate, or transferred from one machine to another.



Using a tap as a tool for obtaining relief or clearance (Fig. 3); center drills (Fig. 4); surface blocks (Fig. 5).



Surface block used as a base for abrasive cloth; method of mounting a large block as an idependent table; a special block for work that must be transferred from one machine to another.

HOW TO CLEAN OILY LEATHER BELTING

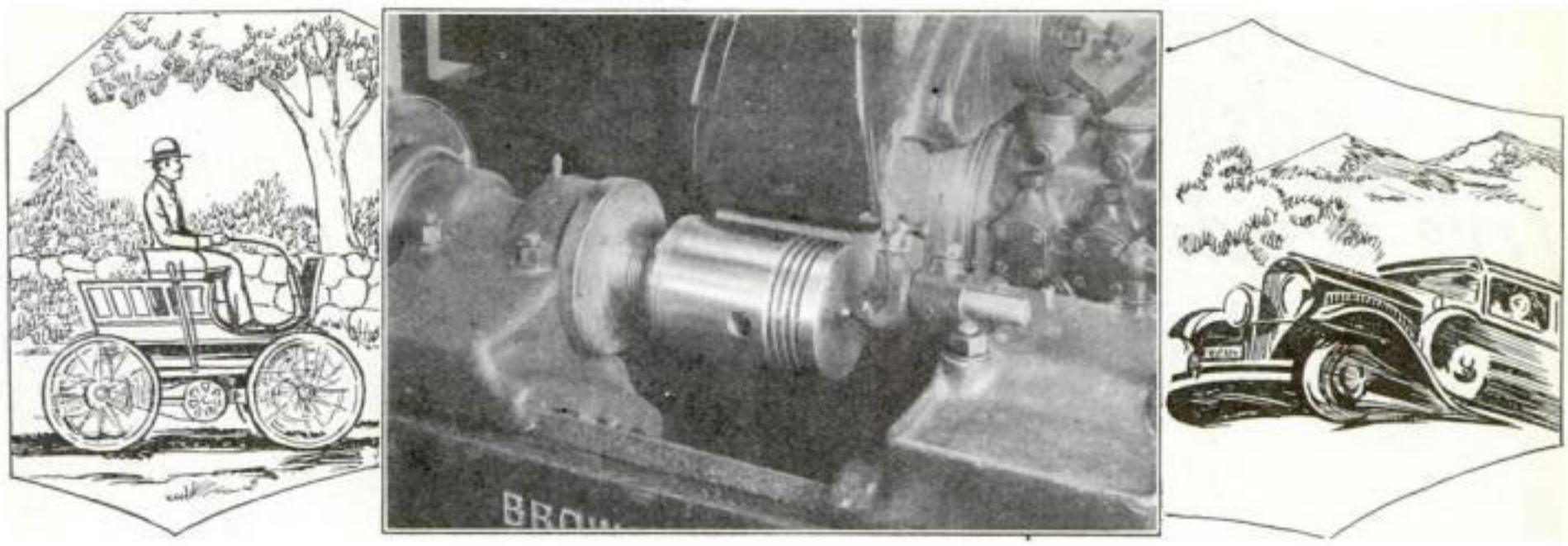
ALTHOUGH oil does not damage some belts seriously, any excess of oil does cause slipping and a loss of power directly proportional to the slip. Continued use of a leather belt soaked in mineral oil also will cause cracks to develop from the fiber abrasion inside, because the protective film of natural animal oil has been removed by the harsh mineral oil.

Excessive slipping furthermore may cause burning of the belt. Burning is often more serious than the power loss, cracking, and abrasion combined.

There are two methods of preventing belts from becoming oil soaked: First, improve the oiling conditions, if possible, so that there will be no leakage or splattering. Second, use a belt that is as immune as possible from being harmed by oil, and clean it periodically.

Numerous cleansing agents are used for washing leather belts such as gasoline, naphtha, kerosene, benzol, carbon tetrachloride, aqua ammonia, alcohol, and soda and water. With gasoline or naphtha, great precautions must be taken against an explosion.

Immerse the loosely wound coil on its edge in the liquid, and let it soak overnight. Then stand the coil on the other edge for ten hours. Any dirt usually loosens and settles to the bottom, but whatever does not come off can generally be removed by brushing or scraping. After the belt is dry, lubricate it with a suitable dressing recommended by the belt manufacturer.—W. F. SCHAPHORST.



Better Cars at Lower Cost

~ *a fine tribute to accuracy*

Compared with early models, any present day automobile is an outstanding accomplishment in design and performance. And, as cars have improved, the cost has steadily declined.

What has made this possible?

Precision tools have played an important part in bringing about these amazing improvements in automobile design. Continual use of these tools has brought about a higher degree of accuracy and the standardization of component parts of the car itself. Thus have automobile manufacturers been enabled to keep pace with the demand for better cars at lower cost.

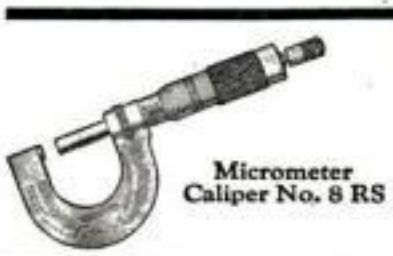
From the beginning of the automobile industry, Brown & Sharpe Tools have contributed to its rapid development. And this is but one of the important industries in which skilled mechanics accept Brown & Sharpe Tools as standard — an acceptance built upon years of satisfactory use.

Our Small Tool Catalog No. 31 describes over 2300 useful tools. Ask your dealer for a copy or write to us for one. Dept. P. S., Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

B·S

Brown & Sharpe Tools

"WORLD'S STANDARD OF ACCURACY"



Micrometer Caliper No. 8 RS

Vest Pocket Speed Indicator No. 746

Vernier Caliper No. 570

Toolmakers' Clamp No. 756

Universal Bevel Protractor No. 496

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

A Modernized Lounging Chair

Herman Hjorth tells how to make one with adjustable back and bookshelves

Fig. 1. A chair of simple construction for any smoking room, boy's room, hunting cabin, or place where men lounge and read.

NO HAPPIER hours are spent than those that come after the strenuous work or sport of the day, when one can lounge at ease in a comfortable chair. But you must have the right kind of seat—one, for example, like the homemade Morris chair illustrated.

The chair consists of three main parts: the sides, the seat, and the back, each of which is constructed independently of the others and the whole joined together in a few moments with screws as indicated in Figs. 1 and 3. The chair may be demounted with equal ease and packed for shipment. Like the other pieces of furniture designed for this series (see P.S.M., Aug. '30, p. 76), the structural members are joined only with nails and screws.

The sides are built up as shown in Fig. 2, their arrangement providing convenient space for books, magazines, smoking accessories, and the like. The filler pieces *E* are put in to support the lower shelf, which carries all the weight of the seat. The piece *F* is bored as indicated so that a dowel or a piece of pipe or metal rod may be inserted between the two sides to support the back at different angles. The supporting rod should fit rather loosely in the holes in order that it may be changed easily from one position to another.

The appearance as well as the strength of the sides will be considerably improved if plywood pieces are nailed to them as suggested. The holes should be sawed with

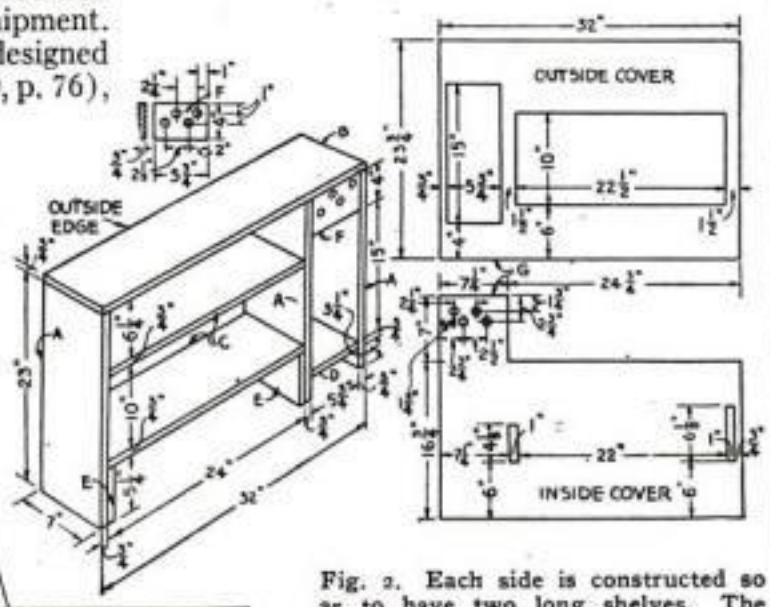


Fig. 2. Each side is constructed so as to have two long shelves. The lower shelf forms the outside bookcase, and the upper one, the inside.

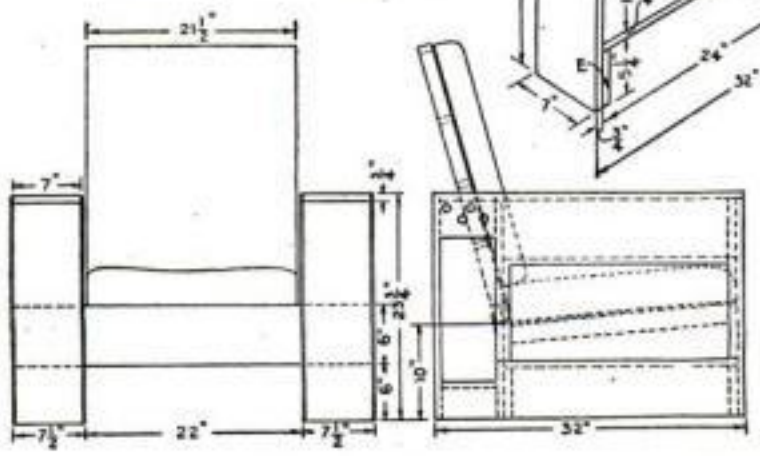


Fig. 3. Assembled views of the chair showing the arrangement of the seat and back. The cushions may be made from an old mattress or from upholsterers' spring units, if desired.

How to Use Your Hand Saws

Told by the Makers of "The Saw Most Carpenters Use"

FOR better work you need Disston Hand Saws, made with Disston skill from Disston Steel: the world's great cutting steel, produced only by Disston in Disston's own steel furnaces.

The *new* Disston Hand Saws are finer now than ever before—improved in every feature. Lighter blades, for easier cutting; narrower blades saves user's strength; true-taper ground, faster cutting; thin, yet stiff; true running; new weatherproof-finish handles; better balanced. They will run with less set, cut faster, cut easier and stay sharp longer, than any other hand saws ever made.

Ask for Disston! Not only hand saws, but every other type of saws for bench or machine work.

Files for the Metal Worker

Every kind, size and style. A Disston 8-inch Mill File, bastard cut, is fine for sharpening axes, lawn mowers, garden tools, and general work in the home and shop. Excellent for finishing metal surfaces. 25 cents each.

"The Saw Most Carpenters Use"

The two handiest saws for the home workshop are the 26-inch 8-point for cross-cutting, and the 26-inch 5½-point for ripping. You will need these on almost every job. The popular "D-8" Lightweights cost $3.45.

Hints on Using a Hack Saw

For cutting pipes, bolts, nails, curtain rods, etc. Strain blade tight. Cut on forward stroke. Disston No. 36½ Hack Saw Frame takes 8" to 12" blades. $2.10. Blades 8", 55c doz; 10", 65c doz.; 12", 75c doz.

Handiest of all Small Saws

The Back Saw, with fine teeth and stiff back, enables you to do smooth, accurate cutting of mitres, grooves, etc., for making furniture, picture frames, etc. Disston No. 4, 12" size, 3" under back, 14-point, costs $3.00.

USE the right type of saw for the work: a Disston cross-cut saw for cutting across the grain of the wood, and a rip saw for cutting with the grain. The teeth are shaped differently, and work differently. For all-around work, use a cross-cut saw with 8 points to the inch, and a rip saw with 5½ points to the inch.

Teeth of cross-cut saw and proper sawing angle

Keep your saws *sharp* and set properly. To start the cut, rest blade on waste side of line, support side of blade with left thumb, and draw saw toward you a few times until a slight groove is formed; then cut straight.

In cross-cutting, it is best to maintain an angle of 45° between edge of saw and face of work. Stand so saw, arm and shoulder are in line with cut. In ripping, keep angle of 60° between saw and work. (See illustrations).

Teeth of rip saw and proper sawing angle

Take long, easy strokes. Don't twist or force blade in the cut. Raise work high enough to keep blade from striking floor. Remember that a Disston saw is a fine tool: do not throw it around. Keep your saw oiled and hung up when not in use.

Good hardware merchants everywhere sell Disston Saws. "The Disston Saw, Tool and File Book," sent free, tells you how to use them most efficiently. Write to us for it.

For Finishing Wood Surfaces

For giving a fine finish to your work, removing paint, etc., use a Disston Acme Cabinet Scraper, made of Disston Saw Steel. Made in all needed sizes, 2½" and 2⅜" wide and 5" and 6" long beng standard. 30c and up.

On Your Power Saw Outfit

With a Disston Circular Saw you can do better work. Disston Steel and Temper make a saw cut easier and stay sharp longer. There is a Disston Saw—cross-cut, rip or combination—for your outfit. Made in all sizes.

DISSTON

***Makers of* "THE SAW MOST CARPENTERS USE"**

Every saw user will enjoy reading "The Disston Saw, Tool and File Book," an illustrated manual on the selection, care, and use of tools. It tells how to file and set saws and contains much other helpful information. Sent free. Use the coupon, or write for it.

Henry Disston & Sons, Inc., Philadelphia
(In Canada, address Henry Disston & Sons, Ltd., Toronto)
Please send me "The Disston Saw, Tool and File Book."

Name and Address .....

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

a fine, sharp saw, preferably a jig saw, to prevent splintering of the veneer. The grain of the outside layer of the veneer should run up and down.

The seat, Fig. 4, is 2 in. higher in the front than in the rear. The three pieces which connect the long front and rear supports must therefore be cut at an angle. This angle may be laid out easily with a steel square by placing it on the piece as shown. Remember that the cuts on both ends of each piece should be parallel. Nail the pieces ¼ in. below the upper edge of the front and rear supports, and cover them with a sheet of plywood ¼ in. thick.

Sides and seat may now be joined, the ends of the front and rear seat supports being slipped into the holes cut in the inside plywood pieces so that they rest on

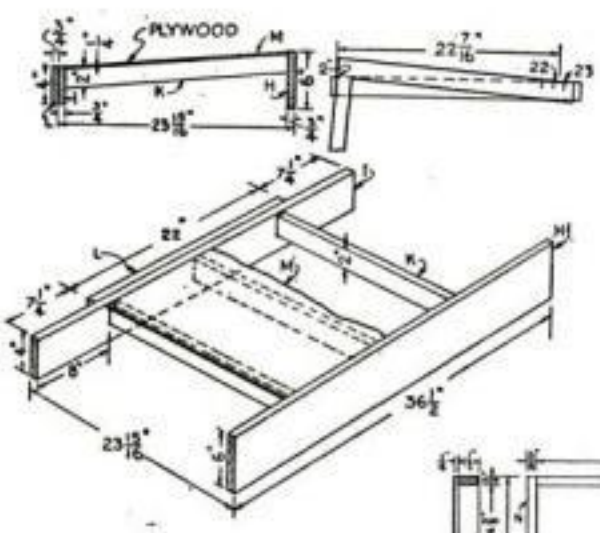


Fig. 4. How the frame for the seat is laid out and assembled.

the lower shelf and butt right up against the outside plywood pieces.

The back is nailed together as shown in Fig. 5 and covered with a piece of plywood. It is hinged to piece *L* as shown in Fig. 4 and also by dotted lines on Fig. 3.

The framework of the chair is now complete and ready to receive the cushions, which should be about 4 in. thick. They may be made out of an old mattress. At a cost of but a few dollars, however, more comfortable cushions may be made from upholsterers' spring units. These consist of rows of small springs 3½ in. high and 2½ in. in diameter, each one inclosed and sewed into a separate pocket. To make the cushions, cover the springs with several layers of cotton felt, stretch and sew a piece of muslin over the whole, and then cover with whatever material is desired.

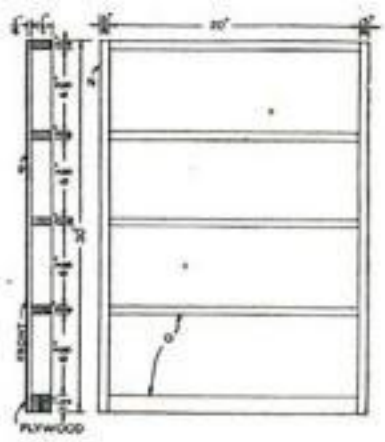


Fig. 5. The chair back. Note that two cleats are used at the bottom, turned edge up.

As the last piece in this series of simply made furniture, a design for a modernistic smoking stand is offered (Figs. 6 and 7). The shelves are nailed to the vertical pieces as shown in Fig 6.

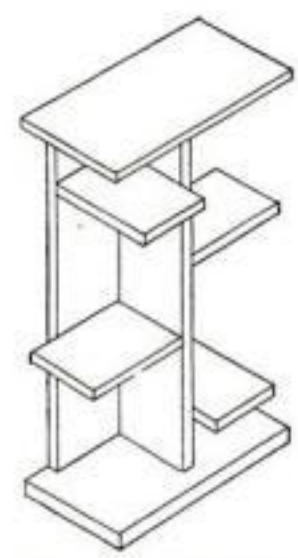


Fig. 6. A perspective sketch of the packing-case smoking stand.

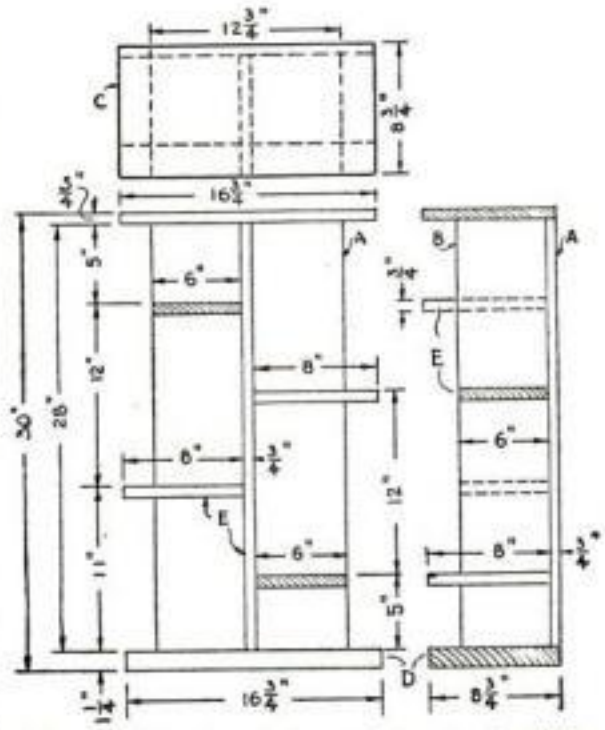


Fig. 7. Dimensioned views of the stand, which is a good companion piece for the lounging chair.

Bill of Materials

No. of Pieces	Description	T.	W.	L.	Mark
	Morris Chair: Sides				
6	vertical pieces	¾	7	23	A
2	top pieces	¾	7	32	B
4	shelves	¾	7	24	C
2	shelves	¾	7	5¾	D
4	supports	¾	7	5¼	E
2	pieces	¾	4	5¾	F
4	plywood covers	¼	23¾	32	G
	Seat Frame				
1	front piece	¾	6	36½	H
1	back piece	¾	4	36½	I
3	crosspieces	¾	2	22 7/16	K
1	filler	¾	4	22	L
1	plywood top	¼	21	22 7/16	M
	Back Frame				
2	sides	¾	1½	30	N
6	crosspieces	¾	1½	20	O
1	plywood cover	¼	21½	30	P
1	metal rod or dowel	¾		28	
1	cushion for seat	4	22	23	
1	cushion for back	4	21	26½	
2	hinges 1½"x3"				
	Smoking Stand				
1	upright	¾	12¾	28	A
1	upright	¾	6	28	B
1	top	¾	8¾	16¾	C
1	base	1¼	8¾	16¾	D
4	shelves	¾	6	8	E

NOTE: All dimensions are given in inches.

FOR drilling chilled cast iron, springs, and saw plate, which resist ordinary and high-speed drills, it is possible to harden a drill for the work. Heat the end of the drill to a cherry red for from ½ to ¾ in. and plunge the end quickly into hard tallow. Then, as fast as the tallow melts, withdraw the drill and push it into another place, continuing until the steel is cold. Run the drill slower than for ordinary drilling, and with less pressure; and do not use any lubricant on the work. The drill is very brittle, but it will work where others fail.—W. L. A.

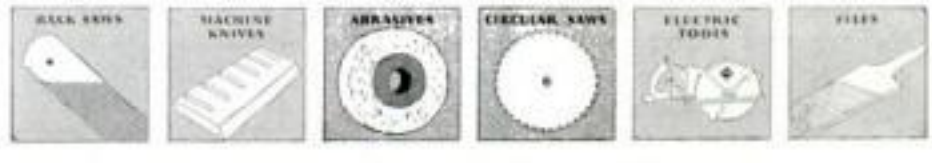
Reproduced from a photograph of Simonds scythe makers—about 1850

HOW THE SCYTHE MAKERS TO NEW ENGLAND BECAME SAW MAKERS TO THE WORLD

BACK in 1832 the ring of hammers and the chime of anvils came from a little Simonds shop... the home of sure cutting scythes. Today, Simonds Industries comprise eight factories, a steel mill and more than a score of sales branches and service stations... Simonds superior cutting edges are used in every clime and country. The one-time scythe makers to New England have become the saw makers to the world.

Spanning a century that witnessed the development of unequalled industrial achievements, the development of Simonds Industries paralleled the growth of American industry—paralleled too, the resulting need for the finest cutting tools. Simonds has led the way to many outstanding advances toward the quantity production methods which have made American industrial practice a world synonym for efficiency... Simonds Industries have grown and will continue to grow because continuous progress, continuous specialization and continuous research are basic principles in the Simonds program.

If you are interested directly or indirectly in Simonds products, write us... Your inquiry will receive prompt attention.



SIMONDS INDUSTRIES

World's Largest Saw Makers

SIMONDS SAW AND STEEL COMPANY

Established 1832 . . . FITCHBURG, MASS.

Boston . .	Mass.
Memphis .	Tenn.
Seattle . .	Wash.
Chicago . . .	Ill.
Detroit . .	Mich.
Portland . .	Ore.
New York .	N. Y.
New Orleans .	La.
Atlanta . . .	Ga.
Los Angeles .	Cal.
San Francisco .	Cal.

Producers of Circular, Band, Metal, Cross-Cut, Gang and Drag Saws... Machine Knives... Files... Hack Saw Blades ... Tool Holder Bits ... Saw Tools ... Discs ... Steel. SIMONDS CANADA SAW CO., LTD., Montreal, Que. ~ St. John, N. B. ~ Toronto, Ont. ~ Vancouver, B. C. AFFILIATED COMPANIES WAPPAT, INC., Pittsburgh, Pa., *Manufacturers of Portable Electric Saws and Tools* ~ ABRASIVE CO., Philadelphia, Pa., *Producers of Abrasive Grinding Wheels and Polishing Grain* ~ SIMONDS GUARANTEED CUTTER-HEAD COMPANY, Seattle, Wash., *Manufacturers of Guaranteed Cutter-Heads.*

BACK OF THE EDGE..THE STEEL...BACK OF BOTH..SIMONDS

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Lapped Joints Improve Belts Used on Power Tools

By FREDERICK D. RYDER, JR.

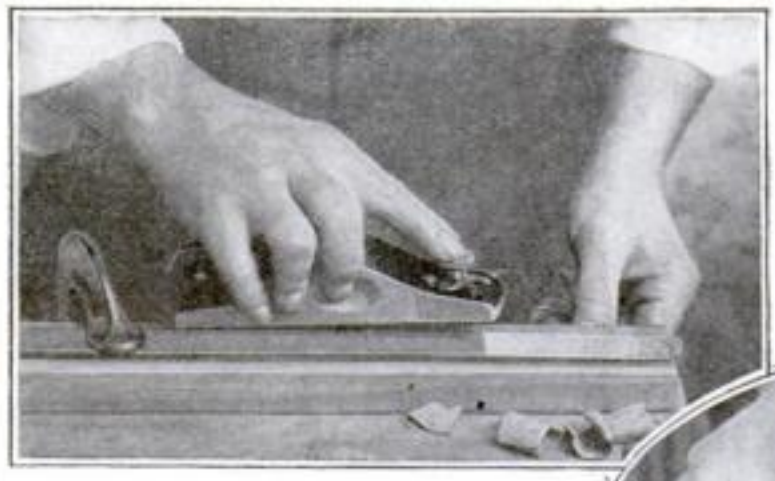


Fig. 1 (*at left*). Using a keen-edged block plane to taper the end of a flat belt ready for cementing.

Fig. 2. Slicing a round belt held in a jig made as illustrated in Fig. 3.

THE construction of a special swinging frame that makes possible instant belt-tension adjustments was described in a previous article (P. S. M., Oct. '30, p. 75). However, quick belt-tension adjustment solves only one of the two important small-tool belt problems. Making satisfactory joints in belts is the other question to be solved.

The ends of flat belts usually are joined by lacing with leather thongs or some form of patent metal belt lacing. On wide flat belts used in factories to drive heavy machinery, a special machine is used to clamp a row of hooks into each end of the belt; then the hooks are interlaced and a special fiber pin is passed through in hinge fashion.

Round belts are almost universally joined by means of a simple metal hook passed through a hole drilled near each end of the belt.

Although these methods are satisfactory for large factory belts that pass over pulleys many inches in diameter, they are not so good on home workshop tools fitted with small pulleys which turn at relatively high speeds. Every time the metallic lacing hits the pulley, there is an annoying click, and on high-speed belts the vibration caused by the lacing hitting the pulley often increases the slipping.

The clicking noises are particularly disturbing if you enjoy, as most amateur mechanics do, the even whirr of smoothly running machinery. In this respect it is about as bad as one loose valve tappet in a six-cylinder automobile motor.

The solution of the problem is to eliminate all lacing by making a cemented lap, which gives an endless, and therefore jointless and clickless, belt.

There is nothing new about this idea as applied to flat belts. In fact, all flat belts are made from pieces of leather only a few feet long joined in the belting factory by the lapping process. Round belt, on the other hand, is cut by a spiral process so that it often is possible to get a piece many feet long that is a continuous strip made from a single cowhide.

One secret of success in belt lapping is to use a good cement. I have found that the ambroid type cement is so perfect for this work that I haven't experimented with the many other flexible cements which, doubtless, would serve the purpose equally well.

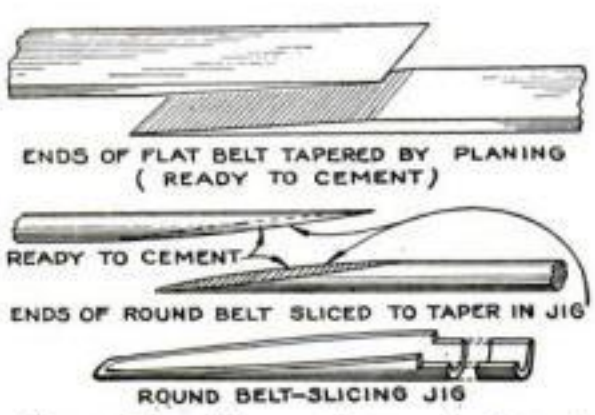


Fig. 3. Belts with properly tapered ends, and a brass jig used for slicing round belts.

THE first step in lapping a flat belt is to pass the piece of belting around the pulleys over which it is to run in order to determine the proper length. Pull it tight so as to allow for the initial stretch, and mark with a pencil where the end reaches on the uncut portion. Then, instead of cutting the belt at that point, measure off 3½ in. more to provide for the lap and cut the belt.

Next clamp one end of the belt to the top of your bench with a short piece of board between the belt and the bench as shown in Fig. 1. Have the end of the belt even with the end of the piece of board. Now take a small hand plane with a sharp edge and plane the belt to a taper, which starts at the pencil mark and goes down to a feather edge at the end. Turn the belt over, reverse it end for end, and repeat the process on the other end of the belt. The length of the taper can be determined by comparison with the end already planed.

After you have the two ends planed so that when held against each other the belt will be the same thickness at the joint as it is elsewhere, coat the surfaces

with cement and allow to dry. Then spread a fresh coat of cement on one of the surfaces and clamp the ends together between two boards. If the machine the belt is to drive has bearings on both sides of the pulley, the belt will have to be cemented while in position around the shafts. Allow the cement to set for half an hour, and the belt will then be ready for the hardest kind of service. A 1-in. belt cemented in this way was allowed to set for a half hour and then put under fifty pounds tension while driving a 9-in. engine lathe that was taking a heavy roughing cut. The joint stood the test perfectly.

ROUND belts cannot be planed in the same manner. Instead of coming to a true taper, the thin end will flatten out into a wide flap that cannot be cemented without producing a large lump on the belt. Round belts should be sliced with a sharp penknife to the proper taper in a special slicing jig, as shown in Fig. 2. The jig (see Fig. 3) is made from a piece of brass tubing having an inside diameter equal to the diameter of the belt. Ordinary 5/16-in. brass tubing has an inside diameter of ¼ in. and therefore is suitable for a slicing jig for ¼-in. round belts.

In slicing, be careful to hold the knife blade as flat against the jig as possible to prevent it from lifting the belt out of the groove and cutting it off short. It is well to experiment on short pieces to get the knack of it before you attempt to lap a belt.

Instead of clamping the tapered ends of round belts together while the cement is setting, wind a piece of bare copper wire around the joint. The particular type of cement used does not stick to smooth metal, so it is easy to remove the wire at the end of the half-hour period.

With care it is possible to make such a perfect lap joint in either a flat or a round belt that you will have to look carefully to find the joint after the belt gets dirty. As for the strength of lapped joints, I have lapped a number of flat and round belts and put them up against severe tests without finding any indication of weakness at the joint.

It must be remembered, of course, that cement will not hold on a belt that has been oiled. If you have to lap a belt that has been oiled or treated with any form of belt dressing, plane the ends and then wash them with dry cleaning fluid or lacquer thinner to remove the oil or belt dressing.

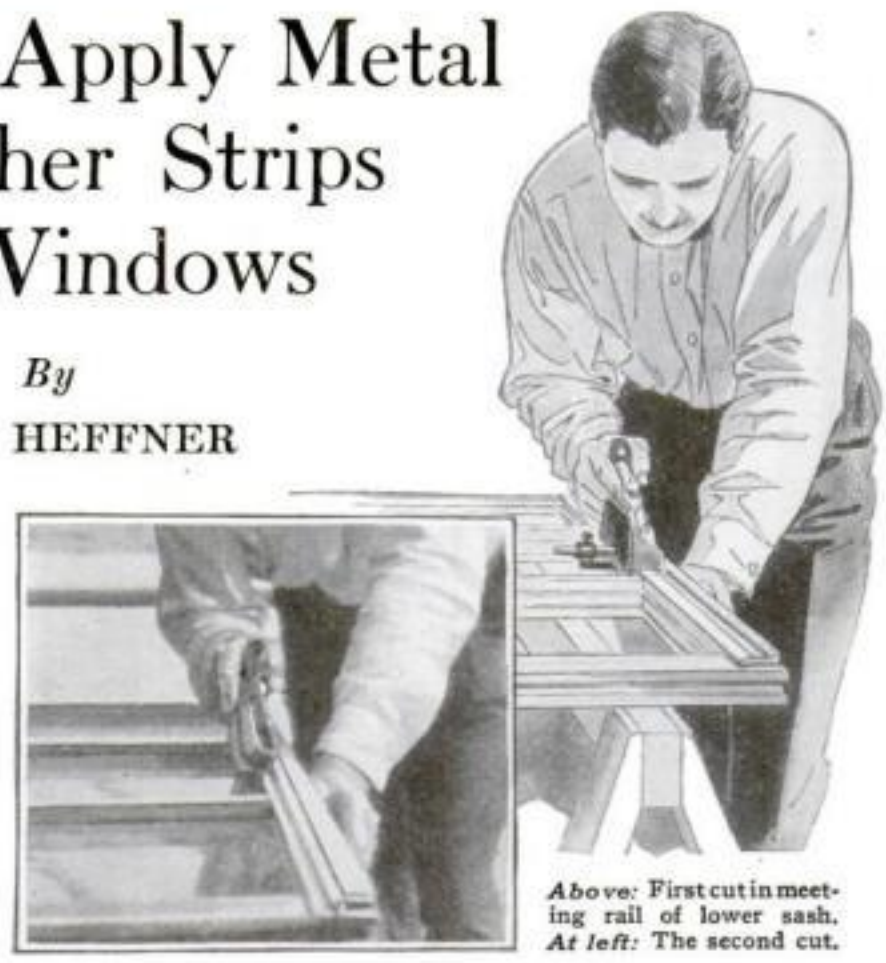
CLEANING A CHIMNEY

SOOT is the enemy of heat and should be removed from flues, smoke pipe, and chimney periodically. First attack it by means of the fire. Every week or two throw a heaping handful of common salt on the hot coals. This will loosen any small accumulations that may have formed and send them flying. Then, each month, throw an old dry cell battery into the fire. The zinc fumes combine with the gases in the furnace to loosen any remaining soot scale. There are also commercial preparations for accomplishing the same purpose.

How to Apply Metal Weather Strips to Windows

By

W. D. HEFFNER



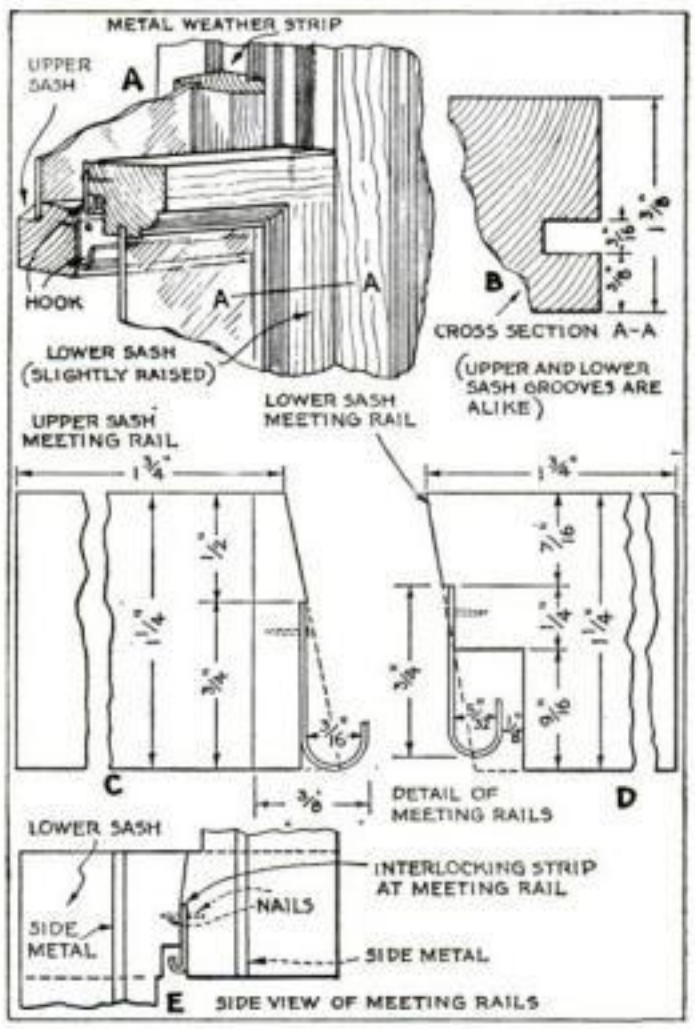
Above: First cut in meeting rail of lower sash. *At left:* The second cut.

TO ELIMINATE the chilling drafts that constantly seep into a house in cold weather and cause discomfort as well as costly waste of fuel, one must seek and seal the source of entry. In most cases the two main points of influx will be found at the doors and windows, which must have sufficient clearance on all sides to allow them to work properly. The modern and most efficient way to seal the joints around these openings is to use metal weather strips.

Any handy man who is a reasonably skillful woodworker and willing to spend the necessary time can install metal weather strips at a considerable saving over the prices quoted by contractors. Indeed, some manufacturers of weather stripping are willing to fill small orders by parcel post or express at the same prices they quote their agents, so the home owner can save the entire labor cost of the installation, which is always high. This being the case, it is obviously better to use high-grade metal strips, even if the work has to be done a little at a time, than to apply temporary and relatively inefficient substitutes of felt or rubber.

The procedure for weather-stripping double-hung windows—that is, the ordinary type of sliding sash—will be described in detail in this article, and the method of applying weather strips to doors will be treated in a following issue.

The metal strips for windows now almost universally used are based on the principle of a simple tongue and groove, with the exception of the joint at the meeting rails—the lower rail of the upper sash and the upper rail of the lower sash. The grooves are made in the wooden sash with a plough plane, or with a circular saw, if available. The tongues are formed by the metal strips, which come all ready to apply to the window frame. At the meeting rails special hook-shaped strips are used in such a way that they mesh one within the other when the window is closed, usually as shown at *A*. The strips as made by various manufacturers differ in design, but clear diagrams and instructions are furnished as a rule. Observe them carefully and also note these general hints:



Typical metal weather strips for windows (*A*); how the sash is grooved (*B*); the meeting rails (*C, D, E*).

JOINTS. There must be enough space in the joint between the sash and the frame to allow for the thickness of the metal strips and for clearance between the strips and the sash. Approximately ⅛ in. on both sides of the upper and lower sashes will be enough. On the other hand, where the joint for both sides is already excessively loose and amounts to more than ½ in., the sash should be packed out with wood strips.

Another detail frequently overlooked is the warp in a sash. If this is not planed out, the sash will always be hard to move. Sashes paint-stuck or tight between the

beads should be made to run smoothly. If a sash for any reason does not work properly before weather-stripping, it is reasonable to assume that it will not afterwards.

If the meeting rails are flush before weather-stripping, or if the rail of the top sash drops below that of the lower sash, plane or saw ⅛ in. or more off the top sash cross rail to allow for the space taken up by the metal head and sill pieces. If no allowance is made for these it will be found, when the job is finished, that the top sash meeting rail drops so far below the lower sash rail that difficulty will be experienced in working the catches and, what is more important, the hooks may not mesh.

WHERE the rail of the upper sash is above that of the lower sash more than ¼ in., the cross rail of the top sash should be packed out with wood strips.

UPPER SASH. Remove one, or both, parting beads between the sashes and scribe for the joint. Take the sash out of the runway and drop as far as the cords permit. Tack the cords to the frame and pluck the knots from the sash, cutting them off 2 or 3 in. from the knot hole to keep from blocking the groove.

After planing for the joint, use a plough plane with a 5/32-in. (or No. 12) cutter to groove the stiles (sidepieces) and top rail on the sides nearest the parting bead, as shown at *B*. This applies to both sashes. The depth depends on the type of metal used, whether the tongue is ⅜ or ½ in. A circular saw, if available, can be used for making the grooves instead of a plane.

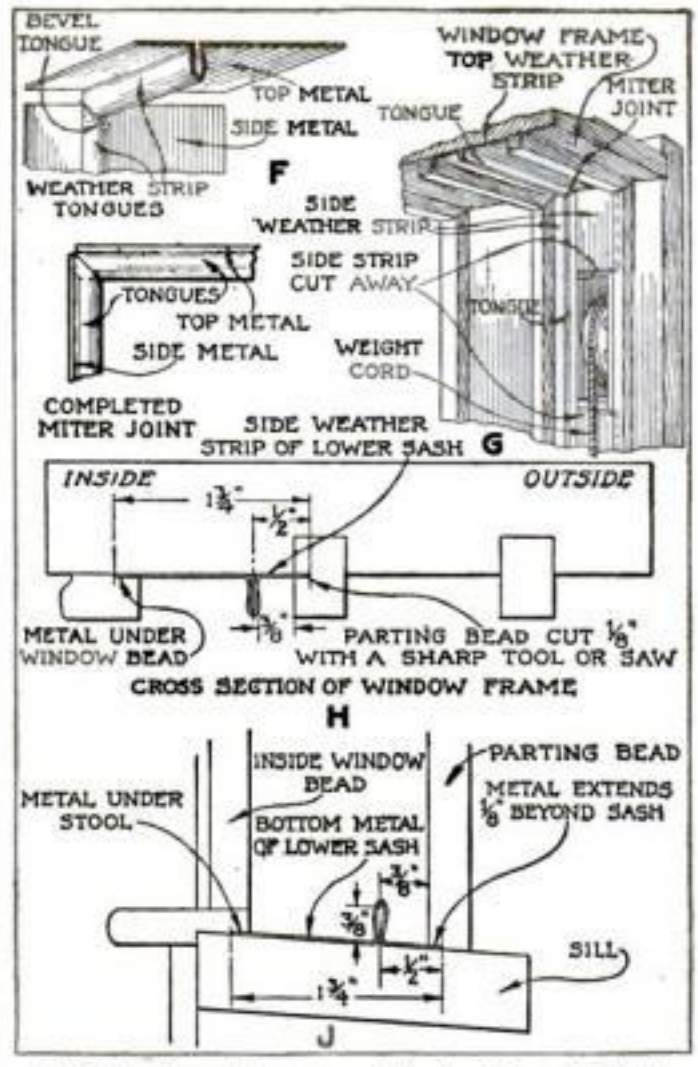
Straight grooves are absolutely necessary. Yet, considering the poor quality of some woods used in sashes, it is sometimes almost impossible to plough clean, straight grooves. By using the effective little side-rabbet plane, a crooked groove can be remedied easily.

Next rabbet the meeting rail for the hook as shown at *C*. The width of the cut depends on the width of the hook. If it is ¾ in. and a 1½ in. rabbet plane is used, gage to this width and rabbet the meeting rail as indicated. The depth of this rabbet varies with the thickness of the hook, being more or less in proportion to the figures shown in the drawing.

That part of the rail that is not rabbeted should be reduced a fraction to eliminate binding when both sashes are closed. This should also be done on the lower sash. The hook is then nailed in. Use 1-in. coated nails and space them from 1 to 1½ in. apart. The weather-stripped meeting rails are shown at *E*.

Before replacing the sash in the runway, install the strips for the top and one side. The top strip, trimmed neatly to the frame, goes in first. The narrow or ⅜-in. flange is always set against the parting bead. Nail in three or four places with ¾-in. tinned nails.

Miter the tongues of the side strips to fit snugly over the tongue of the top strip as shown at *F* and *G*. Cut out the wide flange above and below the pulleys, and nail in either the right or the left side. The side strips should extend ½ in. or more below the sash. Nail in four places



Applying the strips at top of window (*F* and *G*), the strip for the lower sash (*H*), and the sill piece (*J*).

—top, bottom, and above and below the pulleys.

Then nail the cords to the sash with coated nails, and mesh the sash with the strip that has been installed. Place the remaining strip in the free groove and work the sash to its place in the frame. Draw the metal strip up, mesh the mitered end with the top strip, and nail. Wax all metal and wood parts subject to friction with paraffin wax. Then replace the parting beads.

DUST PLUGS. At each end of the window sash, between the meeting rail and the parting bead, there may be spaces varying in width. These spaces can be plugged with felt, rubber, or pieces of cardboard cut to size and nailed to the parting bead. A protective covering of metal should then be fixed over the plugs. The meeting rail of the lower sash must be fitted to these.

LOWER SASH. With but two exceptions—"stepping" the meeting rail and kerfing the parting bead—the lower sash is handled in the same manner as the upper sash.

Groove the stiles and bottom cross rail on the side nearest the parting bead. At the meeting rail, gage the hook from 1/16 to ⅛ in. back from the edge as shown at *D* to prevent binding when the hooks mesh. Rabbet to a depth of ⅛ in. at the highest point. Then, gaging to the end of the first cut, rabbet the second cut flush with the stiles (see illustrations at top of page 108). Nail in the hook, and the sash is ready to be replaced.

Before the sill or side metal can be installed, both parting beads must be kerfed as shown at *H*. That is, a shallow groove a bit less than ⅛ in. has to be rasped in from sill to meeting rail. There is, of course, a reason for this. The metal used for the lower sash has one flange, usually ½ in. wide. As the groove is planed but ⅜ in. from the edge of the sash, the flange will thus project ⅛ in. beyond the edge of the parting bead. This projection is intended to fit in the kerfed groove. Any suitable sharp tool can be used to do the kerfing; or a special tool for this purpose can be purchased, if desired.

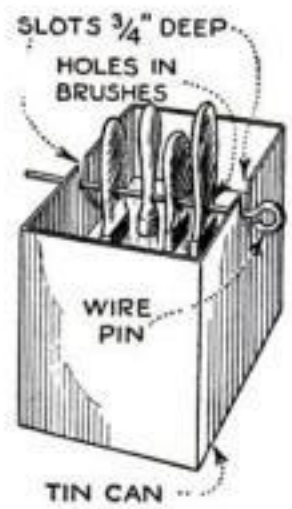
As with the top strip, the sill and one side are installed first, and the remaining strip is worked in with the sash. In most cases, the sill piece is installed by inserting it under the stool of the inside trim as shown at *J*. The ½-in. flange projects ⅛ in. beyond the sash, and its ends are snipped off to pass the parting beads. The narrow flange of the sill piece is nailed securely, but the side strips are fastened in only three or four places so that, when a cord breaks, the metal can be removed without damage. It is advisable occasionally to paraffin all metal strips.

In replacing the inside stop beads, take care to allow enough space between the bead and the sash. Even exceptionally good mechanics have a tendency to fit these stops too close. The consequence is a tight window. And, if the author's experience is any criterion, the Lady of the Manor will express herself right keenly about tight windows.

In an article to follow, Mr. Heffner will outline the methods to follow in weather-stripping doors.

IMPROVED CONTAINER FOR PAINTBRUSHES

BY CUTTING the top from a square tin can, by making slots ¾ in. deep in two opposite edges, and by drilling holes in your paintbrushes just above the metal band, you can provide yourself with a handy brush container. In drilling the brushes, stack them up so that the brush ends are even, and mark the hole centers. Heavy wire will serve for the pin. Fill the can three-fourths full with turpentine or linseed oil and turpentine mixed.—JACOB HOUBRICK.



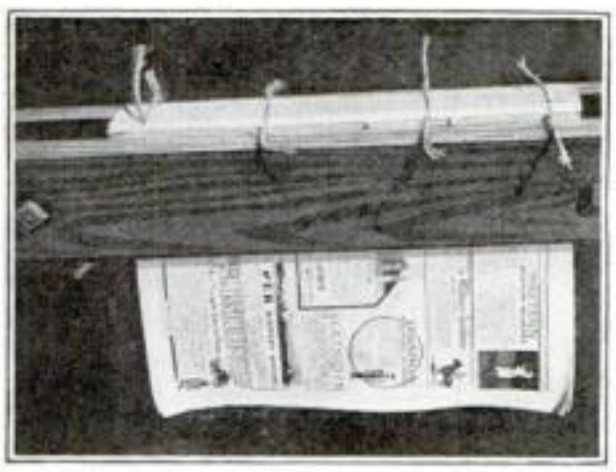
The brushes are held free of the bottom.

OIL stains on wall paper often can be removed by covering them with a mixture of white pipe clay and water. Apply the clay by patting it on, and allow it to dry for at least twelve hours, at which time it can be removed with a soft cloth. Repeat the process if necessary. Unless the design in the paper is extremely light, repeated cleanings by this method will not injure it in any way.

HOW TO BIND MAGAZINES WITHOUT SEWING THE SECTIONS TOGETHER

AMATEUR bookbinders often find that sewing the page sections of books or magazines upon tape or cords is the most difficult part of the work. For one thing, a sewing bench or frame must be provided; then, unless drawn expertly, the thread often tears through the sections, and a single loose stitch is certain to cause a break in the binding at some future time. In the accompanying photograph is shown a method of fastening sections together that will give perfect satisfaction and is much better than a poor job of sewing. I have seen hundreds of volumes bound in this manner.

When the sections of a volume have been made perfectly even at the back



The sections are fastened by forcing loosely woven cord into wedge-shaped saw slots.

and fastened firmly in a vise or clamp, mark where the bands—usually four or five—are to be inserted; then, with a hack saw or a fine toothed miter or back saw, start sawing on one of the marks. Saw straight in for about 1/16 in., and, still sawing, tilt the saw to left and right, enlarging the bottom of the cut while leaving the outer opening only the width of the saw cut. The finished cut should be in the form of an inverted V.

Obtain a loosely woven cord that will fill the enlarged portion of the saw cut completely. Twist the cord tightly to make it small, and draw it into the cut. A screw driver point or a dull knife may be used to assist if the cord tends to balk at the narrow opening.

When all the cords are in place, give the sections a coat of moderately thin glue, leaving the volume under pressure until the glue is nearly dry. At this point trim the edges, if desired.

Round the back, place the volume in a clamp, and set the backing ridges, against which the cover will rest (a shoemaker's broad-faced hammer is excellent for this). Glue a strip of fine cheesecloth over the back, allowing it to extend an inch on each side; this will go on the inside of the cover, with the ends of the cords, when the end papers are pasted down. Glue on one or two strips of brown paper to cover the full width of the back, being sure that they are rubbed down to a perfect contact.

When these are dry, attach the end papers and proceed to cover the volume in the usual manner.—LESLIE H. PHINNEY.

Whittling a Trimotor Model

By DONALD W. CLARK

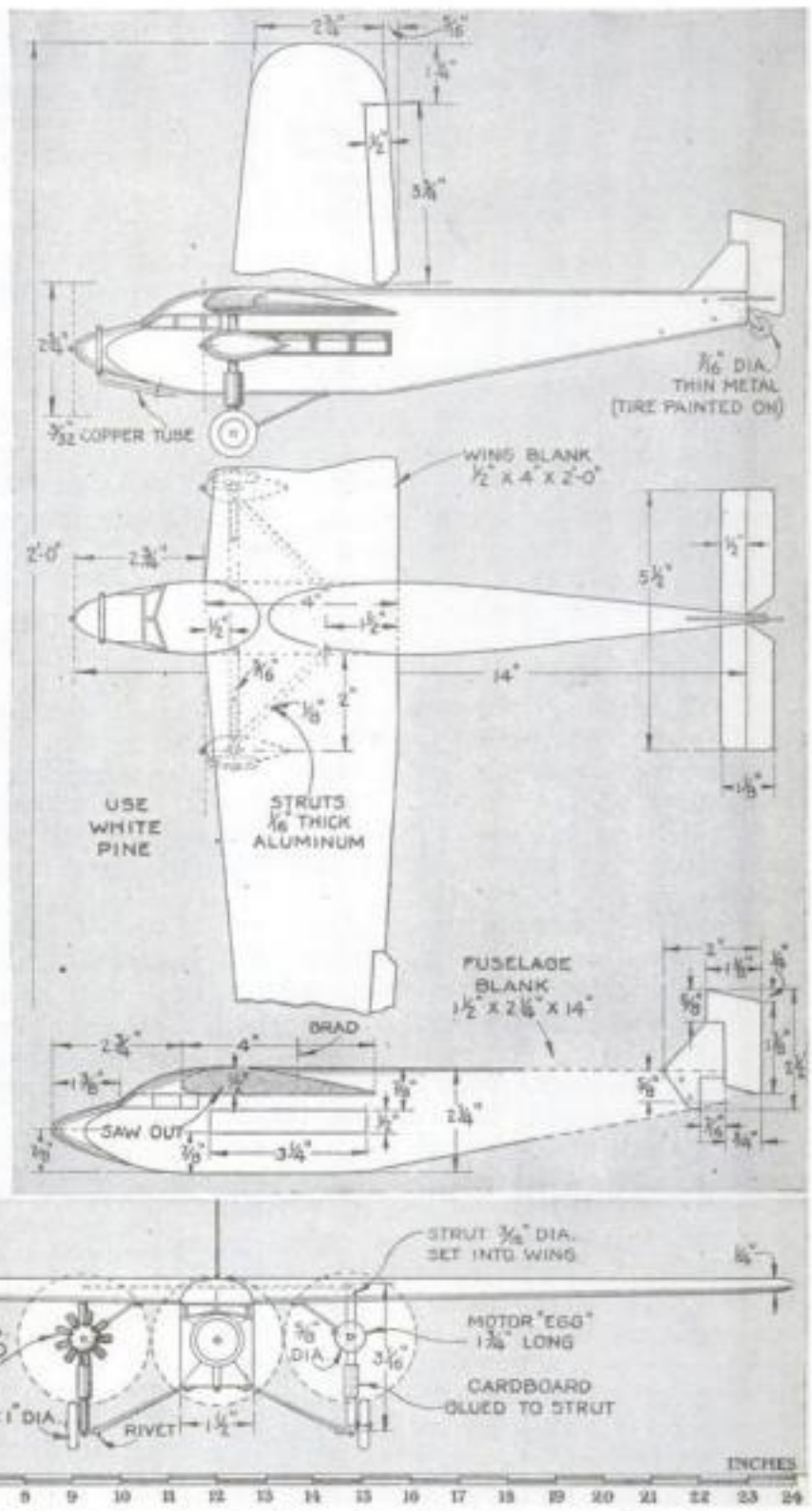
BECAUSE of its simplicity, this Ford trimotor model, which is constructed almost entirely of wood, should appeal to the model maker who does not care to undertake intricate and difficult detail work on so small a scale.

The drawings are self-explanatory. Note, however, that the wing, which is made in one piece, is slipped through a cut-out in the fuselage and is held in place by a single brad. The vertical struts, which are 3/16 in. diameter dowels 3 1/16 in. long, are set 3/8 in. into the wing and pass through holes in the motor "eggs," which are carved from pine blanks 5/8 by 5/8 by 1 3/4 in. The motor cylinders are represented by 3/8-in. lengths of 3/16 in. diameter bolts; and the exhaust pipes, which are made from 3/32 in. diameter copper tubing, can be wired or glued to these.

The tail units are cut from thin aluminum and held in place with two brads. The horizontal tail is placed first; then the vertical tail is slipped down over it, engaging tiny notches cut in the front and rear edges of the horizontal piece.

The two-bladed propellers, which are 2 3/4 in. in diameter, are formed from aluminum or other thin sheet metal.

Color the fuselage, wing, tail, motor "eggs," and propellers silver, and the struts, exhausts, and trimmings black.



Top, side, and front views of the model and a detail drawing of the fuselage and vertical tail unit. Note particularly the sizes of the blank stock from which the various parts are cut.

BLUEPRINTS FOR YOUR HOME WORKSHOP

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

Popular Science Monthly,
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....
.....dollars .....cents.

Airplane Models

50. 36-in. Rise-off-Ground Tractor
69. Lindbergh's Monoplane (3-ft. flying)
82. 30-in. Single Stick
86. 35-in. Twin Pusher
87. 30-in. Seaplane
89-90. *Bremen* (3-ft. flying), 50c
102. Morris Seaplane (record flight 12½ min.)
104. Tractor (record flight 6,024 ft.)

Furniture

1. Sewing Table
2. Smoking Cabinet
3. End Table with Book Trough
5. Kitchen Cabinet
13. Tea Wagon
17. Cedar Chest
18. Telephone Table and Stool
19. Grandfather Clock
20. Flat Top Desk
21. Colonial Desk
24. Gateleg Table
31. Sewing Cabinets
33. Dining Alcove
36. Rush-Bottom Chair
37. Simple Bookcase
38. Sheraton Table
39. Chest of Drawers
49. Broom Cabinet
60. Welsh Dresser
68. Magazine-Rack Table
70-71. Console Radio Cabinet, 50c
77. Pier Cabinet and Wall Shelves
78. Treasure Chests
88. Modernistic Stand and Bookcase
91. Folding Screens
93. Three Modern Lamps
100. Modernistic Book Ends, Book Shelf, Low Stand
105. Tavern Table and Colonial Mirror

Radio Sets

103. One-Tube (battery operated)
42. Three-Stage Amplifier
43. Four-Tube (battery operated)
54. Five-Tube (battery operated)
55. Five-Tube Details
79. Electric
80. Electric High Power Unit
81. Electric Low Power Unit
97. One-Tube Electric
98. Two-Tube Electric
99. Four-Tube Electric
109. Screen-Grid Set

Ship and Coach Models

44-45. Pirate Galley or Felucca, 50c
46-47. Spanish Treasure Galleon, 50c
48. 20-in. Racing Yacht
51-52-53. Clipper—*Sovereign of the Seas*, 75c
57-58-59. *Constitution* ("Old Ironsides"), 75c
61-62. Viking, 50c
63-64. 29-in. Toy Motor Boat, 50c
74-75-76. *Santa Maria* (18-in. hull), 75c
83-84-85. *Mayflower* (17½-in. hull), 75c
92. Baltimore Clipper (8 in. long)
94-95-96. Mississippi Steamboat, 75c
106-107. 42-in. Racing Yacht, *Sea Scout*, 50c
66. Ship Model Weather Vane
108. Scenic Half-Model of Barque
110-111-112. Schooner *Bluenose*, 75c
115-116-117. Concord Stagecoach, 75c
118-119-120. Covered Wagon, 75c
121-122. Clipper Ship in a Bottle, 50c
123-124. Queen's Sedan Chair, 50c

Toys

28. Pullman Play Table
56. Birds and Animals
67. Lindbergh's Plane
72. Colonial Doll's House
73. Doll's House Furniture
101. Fire Engine, Sprinkler, Truck, Tractor
113. Lathe, Drill Press, Saw, and Jointer
114. Airplane Cockpit with Controls

Miscellaneous

15. Workbench
26. Baby's Crib and Play Pen
30. Tool Cabinet, Boring Gage, and Bench Hook
65. Six Simple Block Puzzles

Price 25 cents each except where otherwise noted

Name.....
(Please print name and address very clearly)

Street.....

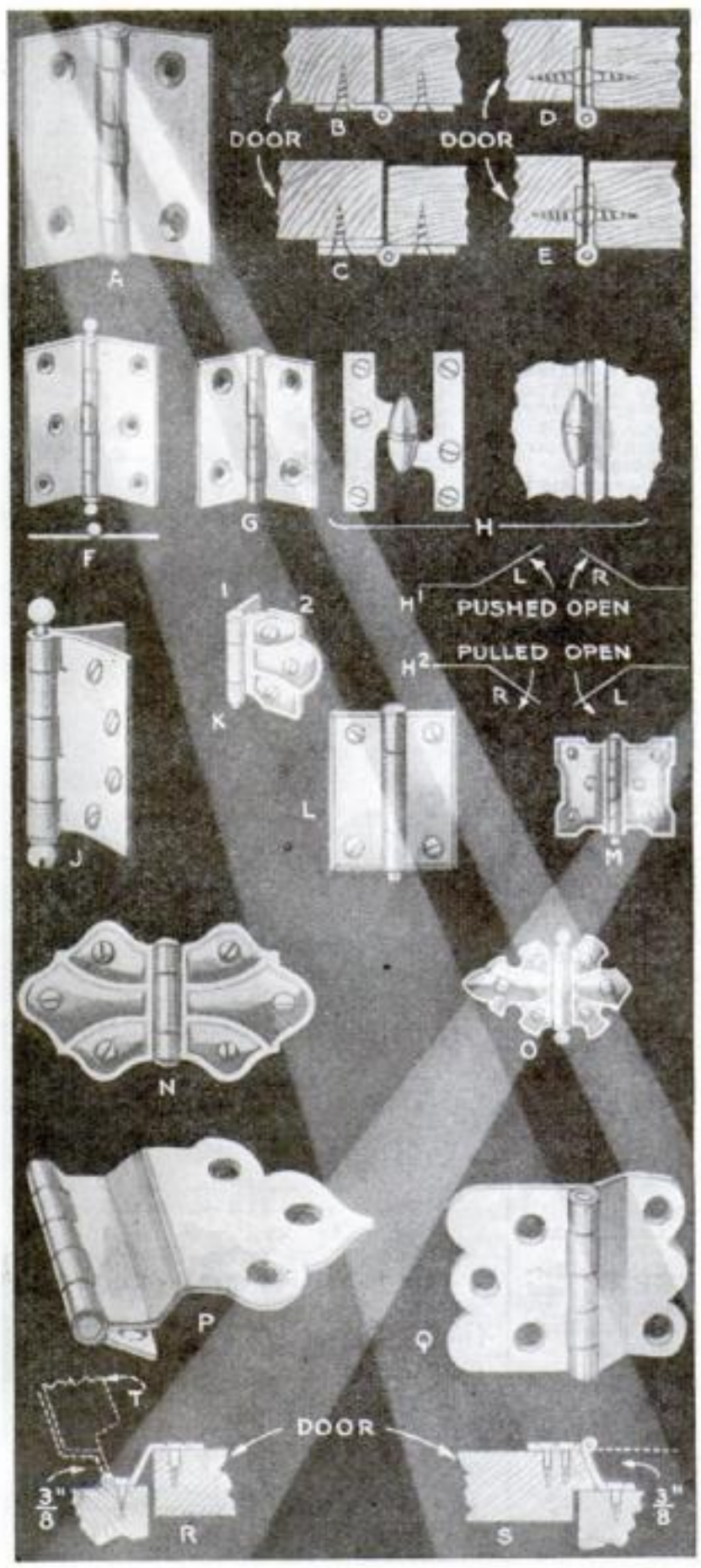
City and State.....

The Right Hinge Saves Work

By DAVID WEBSTER

AMATEUR woodworkers who have built a cabinet, bookcase, or cupboard often encounter difficulty in hanging the doors. They find that some slight change in design or construction would have greatly simplified the door hanging process if they had been familiar with the various types of butt hinges which can be purchased. Few hardware stores carry a full line of all the butt hinges we shall discuss, but every dealer has them all listed in his file of catalogues and can obtain them on short notice.

The plain steel butt *A*, generally used on service cupboards, may be placed as at *B*, the face of the door being flush with the casing or the end of the cupboard; this is, however, not a workmanlike method, although often seen. A piece of pasteboard may be placed between the door and the flap as at *C* and trimmed flush with the edges of the flap. It will not be noticed, and the door will be slightly set back, which is usually an improvement. The usual method of placing this type of hinge is to make a cut a little less than the thickness of both flaps in the edge of the door as at *D*, though upon the best work one flap is cut into the edge of the door and the other into the casing as at *E*. The length of the joints of this type of butt ranges between 1 and 3 in. The butts may be either "fast joint"—that is, with inseparable flaps—or "loose pin," in which case the flaps can be separated by withdrawing the pin.



By selecting the correct hinge and planning the construction accordingly, you can overcome all difficulties in hanging doors.

At *G* is shown the plain brass butt, the type commonly used upon much of the best work. The length of the hinge joint ranges between ½ and 3 in. This type of joint is made in three widths; for example, the 1½ in. narrow butt is ⅞ in. wide when opened; the medium butt is 1 in. wide, and the broad butt is 1¼ in. wide. Usually this type of butt is "fast joint," but the pin can be driven out if necessary. The methods of fitting are indicated at *B*, *C*, *D*, and *E*.

A more ornamental butt made in either steel, brass, or bronze is shown at *F*; it ranges from 1½ to 3 in. in length of hinge joint and is made in different widths. This type of hinge may be fitted by the same methods, though it is seldom placed as at *B* and *C*.

The butt at *H* is an unusually attractive addition to the new designs. It is a loose-joint butt—that is, the door may be easily lifted from its hinges and as easily replaced. The plates, which are 3 in. long, are usually mortised into the edge of the door and into the casing or jamb as at *E*, but they may be fitted as at *D*. The butts are made right or left-hand. If a door is *pushed* open toward the

right, it is a right hand door; if *pushed* to the left, it is a left-hand door, as shown at H^1. If a door is *pulled* open toward the right hand, it is a left-hand door; and if *pulled* open toward the left, it is a right-hand door as at H^2.

At *J* is a half surface butt such as was described in a preceding article (P.S.M., Aug. '30, p. 85). The straight flap may be sunk into the jamb, but it is frequently screwed directly upon the joint surface of the jamb. In fitting this flap, the desired sinkage of the door as at *D* must be considered and the flap set accordingly, as the other flap rests upon the surface of the door. The bent flap (shown in front) is fastened to the door with oval-head screws to give a finished appearance. The butts range between 1½ and 4½ in. in length of hinge joint and may be reversed from right to left-hand or vice versa.

Another semisurface butt of a similar form is shown at *K*. Either flap No. 1 or No. 2 may be fastened to the door or jamb as preferred. The hinge joint is either 1½ or 2 in. long.

Butt *L* is a surface butt, both flaps being beveled; the pin may be removed for convenience in fitting and handling. Sinkage may be secured in these and the surface butts by applying method *C*. Butt *M* is 2 in. long and its simplicity makes it more suitable for a dignified design than the more ornate butterfly hinges which follow.

Different designs of type *N* may be purchased; the length of the hinge joints ranges between ⅞ and 4⅛ in. One flap of butt *O* is narrower than the other, making it adaptable for use with a narrow door stile or casing. This type is made from 1½ to 3 in. in length.

Offset hinges are shown at *P* and *Q;* these are 1¼ in. long on the hinge joint with a ⅜-in. offset. Such hinges are occasionally needed in situations similar to *R* and *S*, or where it is desirable to swing a door out of the way as at *T*, for example, to allow the end book in a bookcase to be removed easily. Larger hinges of similar types may be purchased.

While other designs and sizes of butts for cabinets are made by various manufacturers and may be found in hardware stores, they will conform approximately to one of the types illustrated.

STARTING A NAIL IN A DIFFICULT PLACE

TO START a nail in an inaccessible or awkward place with one blow of the hammer, first grasp it by the point end and force it between the claws as at the right. The head of the nail should rest firmly against the metal neck of the hammer. This method will hold the nail while it is being started even in positions which require one to reach far above the head.

—W. J. B. McGEE.

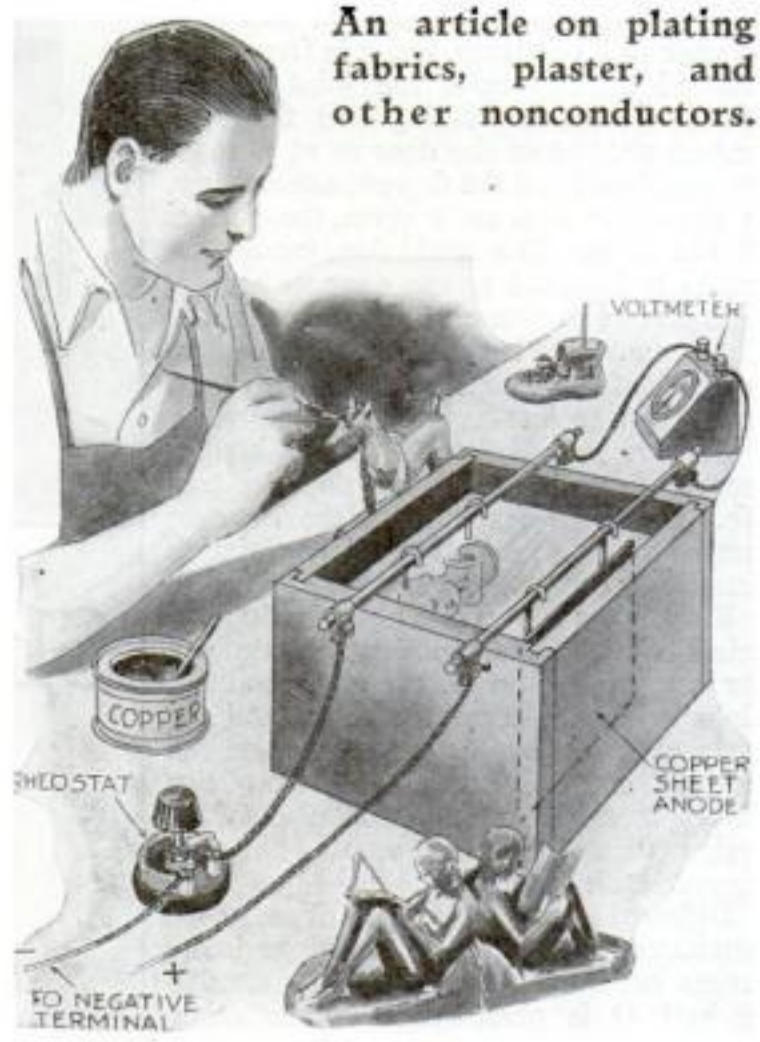
The nail is wedged between the claws.

Copperplating Baby's Shoe *for a Keepsake*

An article on plating fabrics, plaster, and other nonconductors.

By

MICHAEL YANOSKO



Nonmetallic objects may be electroplated if first coated with varnish and dusted with copper powder.

BABIES' shoes, plaster casts, art objects, and novelties of many kinds can be electroplated without difficulty, although they are nonconductors of electricity. Since the work can be done at home and little equipment is needed, the cost is relatively low. The finished articles, however, often command a good price. For example, in the writer's city an electroplated souvenir pair of baby's shoes in bronze finish sell for ten dollars; in silver or gold, the price naturally is higher.

There is so much sentiment attached to babies' shoes and the desire to preserve them is so universal that they will perhaps furnish the most useful example for explaining the process of electroplating over nonconductors, but it will be understood that the same general method is used for any small objects.

The first essential is a crock, a deep tarred wood tray, or a glass container. For small work, a one-gallon glass refrigerator container is the best. Most home workshops are equipped with a small lathe or at least a polishing head, and the necessary cloth buffs and brass wire scratch brushes can be purchased if they are not already on hand.

The solution is obtained by dissolving 1¾ lb. of crystallized copper sulphate in 1 gal. of distilled water. To this solution add ½ oz. of sulphuric acid.

For a power supply a battery may be used—either dry cells or a storage battery, preferably the latter. A 30-ohm rheostat with a power capacity of at least 5 watts is connected in series with the battery and the solution.

The positive terminal of the battery is connected to a copper plate which should practically fill one side of the container. This plate is called the anode. If obtainable, an 0-6 voltmeter should be connected across the plating tank terminals. The scheme of connection is shown in the diagram on the following page.

Suppose we have one of our baby son's shoes to plate—a tiny thing, and delicate. One of the best methods of procedure is first to fill the shoe with plaster of Paris, but do not take out all the wrinkles and folds. Those that are left in must not be deep ones—simply indications.

A bare copper wire of No. 14 gage is stuck into the plaster of Paris through the opening of the shoe. The dried shoe then is painted with electrotyper's varnish, which can be obtained at jeweler's or plater's supply houses. When the varnish is almost dry yet still tacky, a coat of metallic copper powder is applied with a soft camel's-hair brush. This operation must be very thoroughly done.

When the shoe is dry, it should be rinsed in running water to remove the loose copper dust. Then dip it into a strong solution of denatured alcohol and water and rinse in clear water.

Connect the shoe to the negative wire of the battery by the extending wire and turn on the current. Then immerse the shoe in the solution. The current must be turned on before the shoe is placed in the liquid.

If a voltmeter is used, it should show a reading of 1 volt after manipulation of the rheostat; if not, the rheostat should be set at about three quarters of its maximum value and slowly adjusted till the proper plate is deposited. Too much current will cause the plate to be dark or "burnt"; too little current will give a sandy or crystalline deposit. When the current is properly adjusted, a pink flush will spread from the wire over the shoe. While in the solution, however, the deposit appears to be white.

When a sufficient thickness of copper has been thrown down, the shoe is removed

and scratch-brushed with clean water. It is then returned to the solution. Repeat this operation several times. Once a complete coat of copper has been obtained,

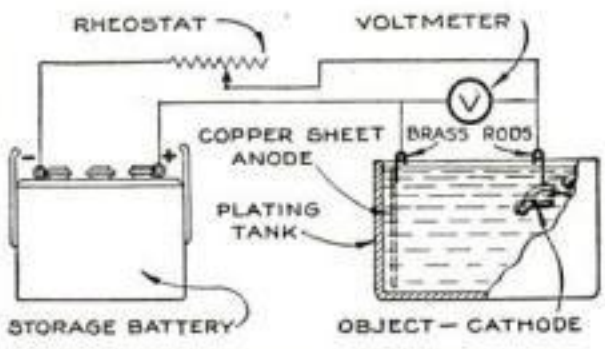


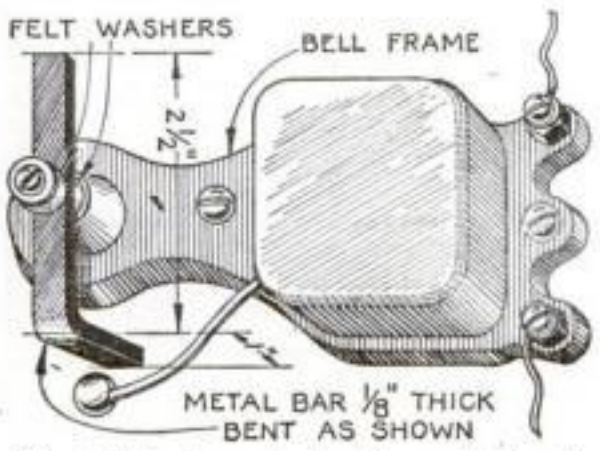
Diagram showing the plating tank (partly cut away) and how the connections are made.

give it as much current as it will stand without burning.

After the shoe has been plated, it should be dried. The plate is then smoothed with a cloth buff and white rouge, care being exercised not to cut through the high-lights. The depressions need not be buffed.

The shoe is next scoured with a hot solution of caustic soda, thoroughly rinsed, and scratched-brushed lightly. Make a hot solution of liver of sulphur and distilled water and apply it to the shoe with a soft, clean brush until a rich brown color has been developed. Scratch brush it lightly and paint it again, leaving the wrinkles and depressions dark. Scratch brush the shoe once more and dry it. Now touch up the high-lights with a dry scratch brush. Finally, apply a coat of transparent lacquer, and the shoe is ready for mounting.

MAKING A DOORBELL RING MUSICALLY



The bell is hung horizontally, and the old gong is replaced with an L-shaped metal bar.

FOR twenty-five cents or less it is possible to convert an ordinary doorbell into one of the new musical bar bells now being used extensively. First, remove the original bell frame from the wall, unfasten the gong, and replace the frame in a horizontal position.

Make the bar, which may be either half-hard brass or monel metal, about 1/8 in. thick and 1 in. wide and drill a hole in about the middle of the longer part to receive the fastening screw. The washers that are used on each side of the bar can be cut from scrap pieces of felt, and the hole in each should be a trifle smaller than the hole in the bar. Fasten the bar on the frame as shown and bend the striker arm until the hammer is about 1/16 in. from the bar.—C. W.

Inside Facts *about* Rubber Motors

By
EDWIN T. HAMILTON

You can't build a record-breaking model plane without having the right motor to drive it.

SINCE the advent of the model airplane and its sudden growth in popularity, many different means of motive power have been suggested, but upon experimentation none has proved as efficient as rubber.

Due to its wide use, every model enthusiast should understand a few of the basic facts concerning rubber and its action. In the first place, rubber has life. There is live rubber and dead rubber. The former allows more energy to be stored in it than in any other source of power of equal weight, while the latter is useless.

Through constant use, rubber becomes tired, and it must be rested before it will regain its energy. Sunlight, oil, grease, certain metals, and the stretching of it beyond its elastic limit will quickly affect rubber, and it becomes hardened, cracked, and dead. These facts point out to the user that he must care for his rubber if he wishes it to work properly for him.

In the early days of model building, any kind of rubber was used; but now that the building of model aircraft has become a matter of scientific calculation throughout, the rubber motor has likewise been improved through research.

There are various sizes of rubber on the market, the most common being 1/32 and 1/16 in. in the square, and 1/8 and 3/16 in. in the flat rubber. The 1/32 in. square rubber is best adapted to very light indoor and rise-off-ground flying models, while the 1/16 in. square is suitable for heavier models of the same type.

THE 1/8 in. flat rubber is by far the most popular size, being the best suited for indoor and outdoor endurance models. Such rubber is actually used on championship models at most national meets. The 3/16 in. flat rubber can be used on all outdoor models and is especially good for large high-speed models.

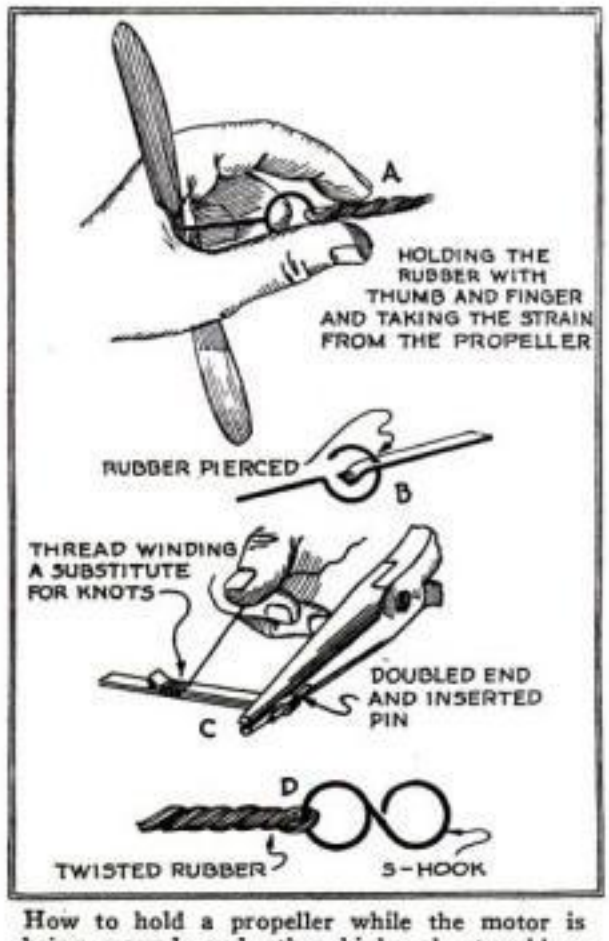
With the above facts in mind, the model builder should try several actual flying experiments, using various sizes, noting the performance of each, and then choosing the best size for the model being tested.

The number of strands is governed chiefly by trial and error. Baby tractors and pushers usually give the best results on one or two strands; larger models require from four to twelve strands, depending on the strength of the motor stick, the size of the propeller, and the weight of the model. If the model is heavy, it stands to reason that more rubber will be necessary.

Rubber always should be applied to a model so that a slight slack is allowed. If using the average length rear hook and propeller hook, the rubber should be the length of the motor stick. In this way, when the rubber is attached, it will have a slack equal to the length of the rear and propeller hooks. "Can" hooks are used to hold the rubber in place near the fuselage or motor stick.

Various kinds of rubber will stretch in different degrees, usually about seven times its length. The purchaser can test the rubber by stretching a measured length about seven times its length, releasing it, and then measuring it again. If the rubber has returned to its original length, it is "live" and good for use in a motor; if it remains longer than it was before, it is not first-class rubber. Any rubber, however, can be distorted by stretching it past its "live length," so care must be taken not to stretch it past this point.

I HAVE seen boys pick over a stock of balsa wood for an hour before choosing that which they wish, and then buy the



How to hold a propeller while the motor is being wound, and other kinks about rubber.

first rubber offered them. Do not do this. Exercise the same care in choosing rubber as you would in anything else of a delicate nature. Dr. William F. Tuley, of the research laboratories of a leading rubber company, gives this hint to model builders concerning the purchase of rubber:

"Chemical substances known as 'anti-oxidants' have been discovered which greatly increase the life of rubber when compounded with it. These substances retard the destructive action of air and sunlight on the rubber. They are being extensively used in tires, bathing caps, raincoats, and other rubber articles, and purchasers of rubber strands for model airplanes might find it advantageous to specify that they be included in the composition of the rubber. There are a number of good commercial antioxidants on the market."

ANOTHER point to watch when buying is that you obtain pure Pará rubber which contains a minimum of nonrubber ingredients and which has been stored in a dark place. Do not buy rubber from an open shelf where the destructive elements of sunlight may harden and crack it. See that it has not been under tension. The writer once saw a storekeeper selling rubber strands off a large ball on which he had wound it—orderly, without a doubt, but poor merchandise.

The safest way to keep rubber when not in use is in a bottle which has been painted black, so that sunlight and air cannot reach it. A mason jar is excellent. Obtain one, pour a little black paint in it, shake it around until thoroughly covered, and then empty the balance. When the paint is dry, rubber can be kept in the jar without fear of damage by light.

If a lubricant has been used, the rubber should be carefully washed in warm water with a pinch of soda and thoroughly dried before it is stored away. When placed in the jar, it should be sprinkled with either common talc or cornstarch after you have made sure that the strands are separated.

Where more than one strand is used for a motor, the winding often causes the strands to stick together. Lubricants are used to prevent this; they make it easy for the strands to slip over each other. It has been proved by experiments that lubricated rubber allows practically twice as much energy to be stored in it as is stored in unlubricated rubber.

There are a number of commercial lubricants on the market, but plain glycerine will be found excellent for this purpose. Do not use oil or grease, as they weaken and soften rubber.

TESTS show that the best winding results can be obtained by stretching the rubber three or four times its length before starting to wind. Two should do this operation together, especially on large models; one holds the rubber while the other does the winding. The latter should walk in slowly as he winds, while his helper should hold the rubber as shown at *A* in the accompanying drawings. The rubber is held on the hook between the thumb and forefinger, and the propeller hub usually will rest in the cavity at the base of the thumb and fingers. Remem-

A definite program for getting ahead financially will be found on page four of this issue.

ber that stretched rubber, especially six or eight strands, has considerable strength, and thin propeller hubs can easily be broken from excess strain.

There are several popular ways of connecting rubber to hooks. Where a single strand is used, the rubber can be pierced, as shown at *B*. While many do this, tests show that the rubber will take many more turns if it is tied around the hooks.

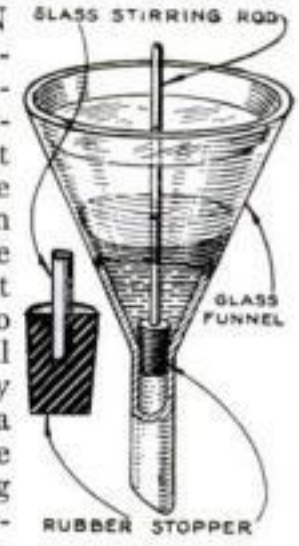
As single strands are used only on small models with correspondingly small fittings, a great amount of trouble is often experienced in making the knot. At *C* is illustrated an easy way to accomplish this. Fold the strand over a pin, hold the two rubbers together with small-nose pliers, tightly wrap with silk thread, and tie. The pin is then held next to the hook, the rubber slipped off it onto the hook, and the pin removed.

As mentioned before, the deterioration of rubber is accelerated by certain metals, the most common of which are copper and brass. If these should be used for fittings which come in contact with the motor, such as rear and S-hooks, "cans," and propeller hooks, they must be wound with silk thread, or covered with spectacle tubing.

When using S-hooks, closing the hook as shown at *D* will be found helpful in keeping the strands together on the hook, and "election" bands on both ends will keep the strands of equal lengths.

FUNNEL FOR SEPARATING CHEMICAL SOLUTIONS

REGULATION separatory funnels with glass stopcocks are rather fragile and expensive, but an excellent substitute may be made from an ordinary funnel of the desired capacity. Fit a rubber stopper to the outlet tube, drill this stopper halfway through with a hole a little smaller than the diameter of a stirring rod, cement the stirring rod into the hole in the stopper, and use as shown in the accompanying sketch. For most purposes this type of separatory funnel answers as well as a costly one.—HARRY B. MAXWELL.



Cheaply made funnel of separatory type.

A SOCKET-WRENCH KINK

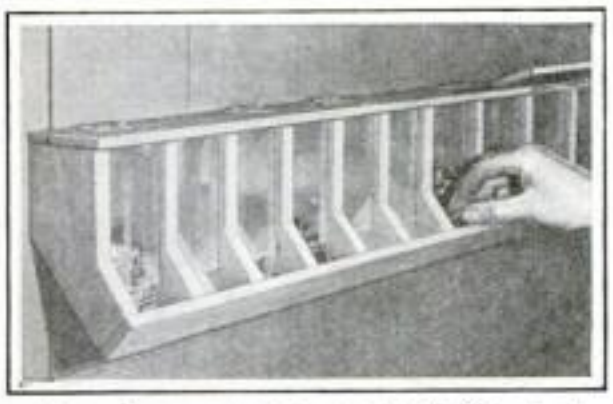
Using a shim on an oversize socket.

IN WORKING on my car recently, I came across some nuts which none of the sockets in my socket-wrench set would fit. By bending a small piece of sheet steel as shown and using this with a slightly oversize socket, I was able to turn the nuts with ease and without danger of damaging them.—BURL KNUTSON.

GLASS-FRONT HOPPERS FOR HOLDING NAILS AND SCREWS

MORE convenient than either glass jars or labeled drawers, this home workshop container for nails, screws, or other small parts is built on the order of an automatic chicken feeder. It consists of a series of glass-front hoppers, the contents of which are always available in the divisions of what corresponds to a trough running across the bottom.

The hoppers are filled through the openings at the tops, which are covered by



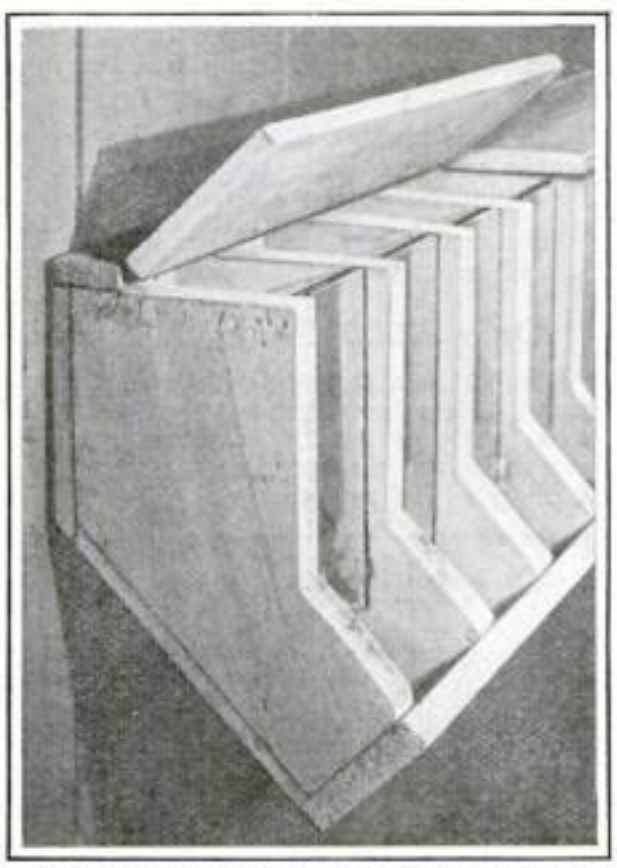
At a glance you can see just what is in these unusually convenient workshop hoppers.

hinged lids. The glass fronts serve the triple purpose of retaining the contents, making their identification easy, and allowing the quantity available to be estimated at a glance. With a container of this kind, there is no excuse for running short.

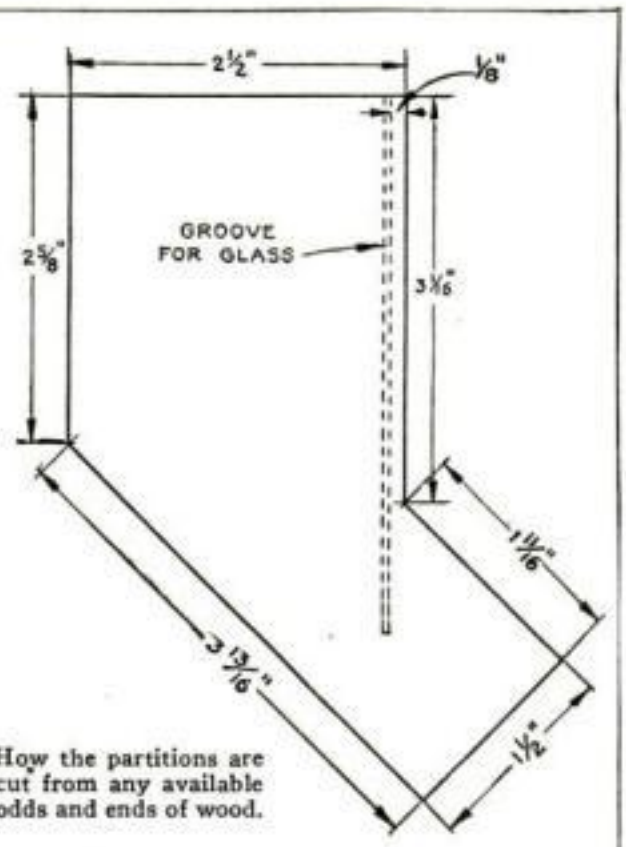
In constructing the container, cut the necessary number of partitions according to the drawing at the top of the following page. Groove them on both sides to receive the glass pieces, except the two outer surfaces of the end pieces. It is well to make half of the series of hoppers each about 2 in. wide and the remainder 3 in. A 2-in. width will do for small screws or nails.

The lid covering the hoppers may be in one piece or in several sections. In the twelve-cell holder shown, three lid sections were employed.

The glass, after being cut to shape, is



A larger view of one end of the hardware container showing one of the lids raised.



How the partitions are cut from any available odds and ends of wood.

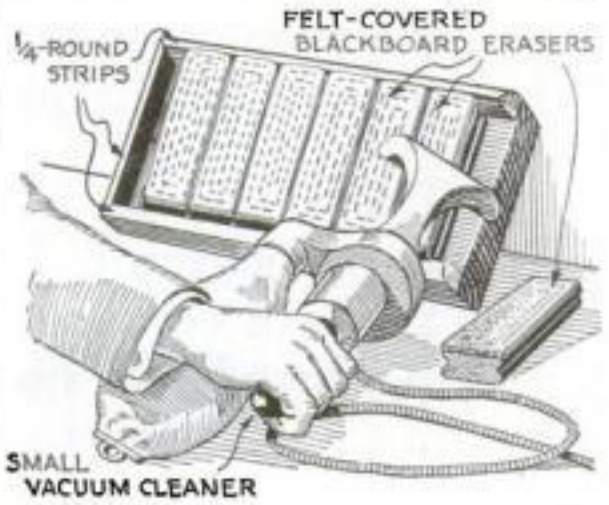
rubbed on a piece of sandstone to round the top and bottom edges so the fingers will not be cut.

The container should be hung on the wall immediately above the bench or in some other position within arm's reach of the bench.—WALTER E. BURTON.

A QUICK WAY TO CLEAN BLACKBOARD ERASERS

CLEANING blackboard erasers, which is a problem in many schools, may be easily solved by using an ordinary vacuum cleaner with an attachment such as is provided for furniture and draperies or one of the small so-called "whisk broom" cleaners, as illustrated.

A number of erasers can be cleaned at the same time by making a wooden frame to hold six. This frame is merely



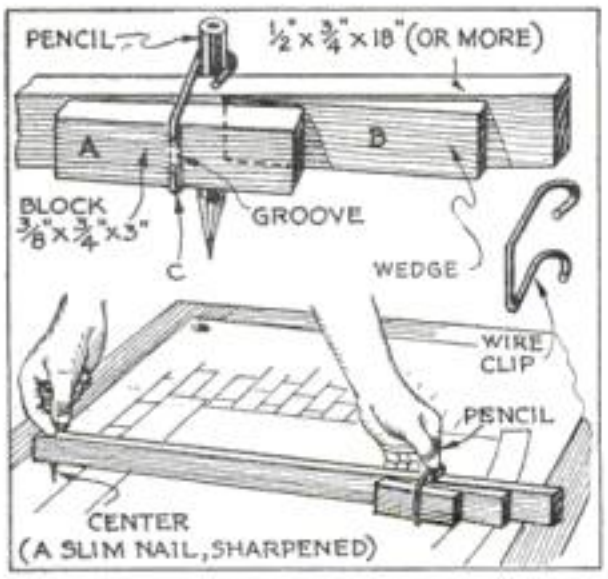
Half a dozen erasers are squeezed into an open-ended frame and cleaned at one time.

a board about 8 by 14½ in., around three sides of which are nailed pieces of quarter-round base molding or any other available strips. The erasers must fit snugly when pressed in from the open side.

The vacuum nozzle with its narrow opening should be held firmly against the layers of felt and rubbed back and forth briskly for half a minute to extract the dirt. Removing the chalk by this method does away with the unsightly practice of clapping erasers against walls or furniture and saves the children from inhaling crayon dust.—OSCEOLA MADDEN.

WOODEN BEAM COMPASS FOR LARGE CIRCLES

WHEN you have to describe circles bigger than the capacity of your largest compasses, you can easily improvise a beam compass. Take a strip of wood about ½ by ¾ by 18 in. or longer, drive a slim nail through it edgewise near one end, and file the projecting end smooth and sharp for a center. Whittle two small blocks of wood to the shapes shown at *A*



An expensive beam compass, and a detail of the pencil holder and wedge adjustment.

and *B*, the first being ⅜ by ¾ by 3 in. and the second being a trifle narrower. From a piece of wire bend a square U-shaped yoke to fit over the piece *A* and the bar. Lay a pencil against the other side of the bar and bring the ends of the wire around as shown at *C*, with the wedge *B* about halfway under *A*.

By loosening the wedge, the pencil holder may be slid along the bar to any desired distance from the nail forming the center point.—CHARLES A. PEASE.

HANGING CURTAIN RODS

THE little paper or cardboard square illustrated is an aid in fastening curtain rod brackets so that they are uniformly located and so that the rods will be level. It saves making individual measurements at the upper corner of every window casing.

Cardboard guide aids in placing brackets.

While the gage is held at the corner of the window trim, the bracket is set in the inner angle and nailed or screwed in place. For the opposite corner, merely reverse the square.

In the example shown, the brackets were set 1½ in. from the outside edge and 2 in. from the top of the casing, but the dimensions, of course, may be whatever is desired.—SARAH MORRISH.

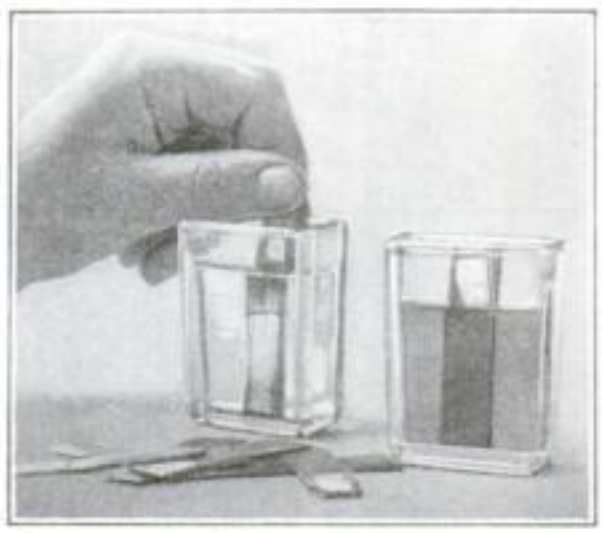
WHILE light and good ventilation are important wherever varnish is drying, drafts should be avoided, since they tend to cool and roughen the varnish.—G. V.

Chemicals Used for Tinting Brass

PERMANENT colors can be given brass by submerging it in certain easily prepared salt solutions. In this way chests may be ornamented with brass corners, hinges, and bands that have been colored to give a more pleasing effect than the plain metal; and it is also possible to prepare brass inlays of various colors.

The colors imparted to brass may be varied from a golden yellow resembling gold to red, brown, blue, and black. Although permanent enough so that they cannot be rubbed off easily, the colors can be removed at any time, if desired, by using sandpaper or some other abrasive.

Since the composition of brass varies considerably—there is 60 percent of copper and 40 percent of zinc in ordinary



Brass can be given a variety of colors by the use of easily mixed chemical solutions.

brass, while tube brass has 70 and 30 percent of these metals—the colors developed by the chemicals will differ accordingly. It is best, therefore, to test the chemicals beforehand on a scrap of brass of the same kind or on an extra fixture, experimenting until the right shade is obtained.

Steel gray to steel blue. Dissolve ½ teaspoon of antimony chloride in a large glass of water to which 2 tablespoons of hydrochloric acid have been added. Dip the brass into this solution until the desired shade is obtained.

Steel blue to black. First make a precipitate of carbonate of copper by dissolving copper sulphate (blue vitriol in water); then add a strong solution of washing soda (sodium carbonate) in water to the copper, and filter off the light blue precipitate. Wash the precipitate by pouring fresh water over it. Now take the precipitate, 3 teaspoons to a glass, and dissolve in liquid ammonia until a clear, deep blue solution is obtained. Immerse the brass in this solution until a satisfactory color develops. The solution is especially effective when used hot.

Red to brown. Dissolve the light blue precipitate of carbonate of copper obtained by adding sodium carbonate to copper sulphate, as above, in 3 teaspoons of lye (sodium hydroxide) to a glass of water. Brass placed in the cold clear solution will turn red. Placed in the hot solution, the metal will take on a darker red and pass by degrees to a brown color, depend-

ing on the length of time it is submerged.

Coppery color. In a glass of water dissolve 1 level teaspoon of potassium chlorate and ½ teaspoon of copper sulphate. Heat the solution and submerge the brass until the color is developed.

Violet to blue and blue black. Dissolve 1 teaspoon of copper sulphate, 1 teaspoon of hyposulphate of soda (hypo), and ½ teaspoon of tartaric acid in a glass of water. Place the brass in the hot solution, which will give a thick, yellow precipitate and deposit a yellow coating on the metal. Rub off the yellow with a rag, and the brass will be found colored a deep red which merges from violet to blue-black.

Bright yellow. Dissolve ½ teaspoon of potassium chlorate and ½ teaspoon of nickel nitrate in water and place the brass in the hot solution. The color will vary from bright yellow to brown.—H. BADE.

CAN YOU EDIT THESE SHOP STATEMENTS?

HAVE you enough information at your finger tips to enable you to go about the work in your home shop with a reasonable amount of assurance that you are doing the right thing in the right way? If you have, you should encounter little difficulty in editing the statements below by crossing out the incorrect terms. A glance at the correct answers on page 131 will soon tell you whether you have retained in each case the word or words that supply the right meaning.

1. A hand tool used to cut threads in a hole or on an internal surface is called a *(reamer) (tap) (mandrel).*
2. The center terminal on a dry battery is *(positive) (negative).*
3. *(Auger bits) (Twist bit-stock drills)* are graduated in 1/16 in. steps.
4. Lighting fixtures in the home are usually connected in *(series) (parallel).*
5. A No. 6 wood screw is (*larger*) (*smaller*) than No. 10.
6. The priming coat of paint is applied *(before) (after)* all holes are puttied.
7. The length of a flathead wood screw is determined by *(the length of the shank) (the over-all length of the screw including the head).*
8. Varnish is thinned by adding *(alcohol) (turpentine).*
9. The set of the teeth on a saw blade supplies the *(cutting edges) (clearance).*
10. In decorative metal work, the metal should be *(tempered) (annealed)* before the hammering process is begun.
11. The portion of the step on which we walk is called the *(sill) (tread).*
12. *(Alcohol) (oil) (water)* stain will not cause the grain of the wood to become noticeably raised.
13. Go *(across) (with)* the grain when rubbing off a paste wood filler.
14. In finishing, rottenstone and oil should be applied *(before) (after)* the pumice stone and oil, since it cuts *(less) (more)* rapidly than the pumice.
15. In mixing an outside white lead paint for new wood, the second coat should contain *(more) (less)* oil in proportion to the white lead than the priming coat.

How *to* Imitate Tile Effects *with* Stencils

By BERTHA ANNE HOUCK

Brilliantly realistic tile effects can be obtained with painted stencils.

TO IMITATE a tile effect with stenciled designs requires only a stencil pattern, a stencil brush, and some paint. The method is especially useful in an old house where it is impractical to reconstruct a wall for laying genuine tiling and in any building, new or old, where the effect of tiles is desired at a small cost.

A tile border pattern should be selected that has the kind of design one expects to find in real tile, although this is not limiting, as tiles come in a great variety of patterns. Large paint stores stock all kinds of ready-made stencils.

Any semitransparent paint, especially mixed for stenciling, will be satisfactory if it is chosen in the right colors to harmonize with a room. Appropriate places to use a tile stencil are around a fireplace; on the walls around a doorway, exterior or interior; as a wall plaque or on the risers of stairs of a house which is decorated in the Spanish or Italian spirit; and in all bathrooms.

Paints for stenciling may be either tube glazing colors or ordinary house painting colors which have been thinned with a glazing liquid composed of one fourth linseed oil and three fourths turpentine, or three fourths turpentine and one fourth Japan gold size. If an excess of either Japan or linseed oil is used, it will tend to make the paint glossy, and this is a desirable quality when one is aiming after a glazed tile effect. When thinned, the color should be about the consistency of cream.

If two painters are working together, one should hold the stencil in place while the other one fills in the cut-outs. If one is working alone, it is necessary to keep the stencil firm with thumb tacks or a mixture of glue and size, which will hold the corners of the stencil transfer in place and leave no mark when it is removed.

While stenciling is simple enough in itself, there are two pitfalls which must be avoided: imperfectly matching the design and smearing it when taking the transfer from the surface, after the paint has been applied through the cut-outs. However, care and deftness will prevent both of them. If, as is generally the case in a simulated tile effect, the border is a succession of similar figures, the only difficulty in spacing comes at the end.

Suppose a Spanish room is being decorated with a stenciled dado in imitation of tile. The decorator should first measure the wall space to determine whether or not the end of the stencil will come at the corner of the room, because the last tile in a border generally fits exactly into a corner. The line which the stencil is to follow should be carefully measured and marked off with chalk before the painting is started. A slight discrepancy at the beginning may grow to grotesque proportions before a border is completed. Proper planning will prevent this difficulty, because it is almost always possible either to gain or lose a little as one goes along to make the spacing come out right.

It is necessary to have a separate pot and brush for each color. Stencil brushes may be had in a variety of sizes. A No. 2 brush is a good size for the average small stencil used to imitate tile. In blocking in the design, the brush should be used like a hammer instead of being stroked back and forth in the ordinary manner. Keep the brush at right angles so that the bristles will not get under the stencil and make a ragged, mussy edge, and pound it through the cut-outs, using very little paint.

When all the cut-outs have been painted in, the stencil is lifted off with care. The best method to follow to avoid smearing is to pull it straight away from the surface. It is a good idea to clean the back

How a stencil brush should be held. It is used with an up-and-down pounding motion.

of the stencil with a rag dipped in gasoline each time it is used.

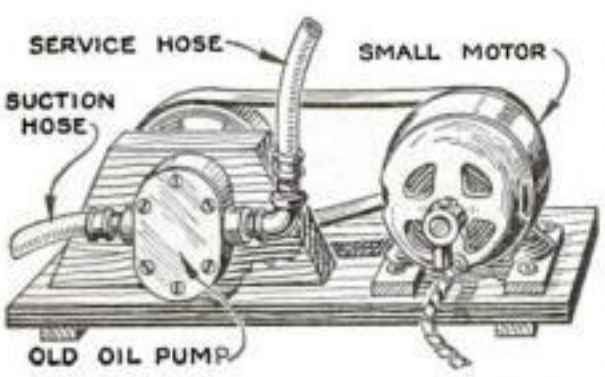
Other stenciling methods which may be employed to simulate tile are known as "background" and "outline." To paint a background stencil, the border is chalked off and painted in solid color. When dry, the stencil is used in the manner previously described. This will be found the best method for ordinary tile effects. For an outline stencil, the design is outlined with a fine line, generally of black, or of burnt umber to suggest the natural colored pottery lines often found in tile designs, and then filled in free-hand.

If the design is not made up of separate units, whether it is a border or a large design, it is frequently blocked off in squares to give a tile effect after it has been stenciled on the walls. The block-off lines are put in with burnt umber or paint mixed to represent the mortar color.

OLD OIL PUMP DRAINS FLOODED BASEMENT

A SURPRISINGLY efficient little water pump may be obtained by connecting a discarded automobile oil pump to a small electric motor by means of a fan belt taken from an old car.

Such a pump is a labor saver in draining a flooded basement and it is equally useful for providing running water with which to wash an automobile in a locality



A powerful little water pump made by belting a junked automobile oil pump to a motor.

where the water supply comes from wells or springs.

The oil pump is mounted on a block of wood as illustrated, two screws on the other side of the block holding it steady, and the block is fastened securely to a plank. A small pulley is placed on the shaft of the pump and belted to the motor, which in this case was taken from a washing machine.

Two pieces of hose are attached. If the pump is to be used to supply water, as for washing an automobile, the suction hose may be placed in a sump or a watering trough, or it may be connected with your garden hose. When the pump is desired for draining a basement or similar purposes, the suction hose must reach to the lowest point to be drained.

The pressure depends upon the size pulley to be used on the pump. It is recommended that the pulley be a little larger than the one on the motor so as to run the pump at about 1,200 R.P.M.

You will be greatly surprised at the work that this little pump will do. By holding your thumb partly over the end of the service hose, you can easily squirt water 50 ft.—HAROLD C. KIMBALL.

A definite program for getting ahead financially will be found on page four of this issue.

Simplifying Your Ship Models

By A. R. McCRACKEN
Lieutenant, U. S. Navy

MANY of the more difficult details in the building of ship models may be obviated by using timesaving kinks and simplified methods of construction.

For instance, many parts used in the rigging of a ship can be made from celluloid of the type to be obtained in the form of a flat comb in almost all "five-and-ten-cent" stores. Celluloid is easy to shape, and the resulting part will be strong and neat in appearance. The parts can be cut out with a hand scroll saw and finished with small files. Designs in pencil are easily laid out on smooth celluloid if the surface is roughened slightly with fine sandpaper.

Tops and crossjacks are among the parts which can be formed from celluloid. In the larger models the standing rigging runs through notches cut in the edges of these parts, but in smaller models fine holes drilled near the edges are more convenient to make, and the lines run through them will not slip out of place.

The upper shrouds about a topmast may be rigged from one piece of thread if holes are drilled in the mast where the top and bottom of the shrouds are to come. Run the thread in continuous loops as shown in Fig. 1, then haul the line taut and tie the ends in a square knot close to one of the holes in the mast. Put a drop of cement on all knots before clipping the ends.

Channels may also be cut from celluloid as shown in Fig. 2. File the inside edge of the channel so that it will fit the curve of the ship's side. Drill two holes through the channel edgewise and tack the channel to the side of the ship with small pins. A No. 60 drill should be large enough for these holes.

Small anchors may also be shaped by sawing and filing the two celluloid parts shown in Fig. 3 The notch in each piece can be cut with a file such as is used in adjusting spark plugs. Put a drop of cement on the joint, wrap it with two or three turns of thread, and cement the knot before clipping the ends. The anchor may be painted black.

The difficulty of making skids to fit small solid boats is eliminated by notching the boat to fit the skids in the manner shown in Fig. 4. Saw two straight pieces of celluloid for the skids and drill a hole (edgewise) in the center of each. Turn the boats bottom up and at the appropriate points file slots right across the bottom with a spark plug file held on edge. The width of the slot should be just sufficient so that the skid will fit tightly. The skids are fastened to the deck by driving pins through the holes and the boats are fastened on the skids with glue.

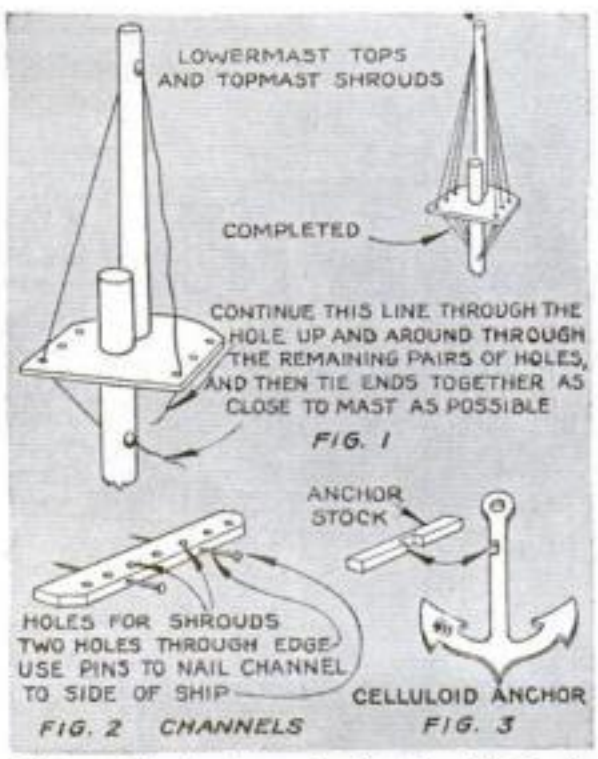


Fig. 1. Rigging topmast shrouds. Fig. 2. A celluloid channel. Fig. 3. Celluloid anchor.

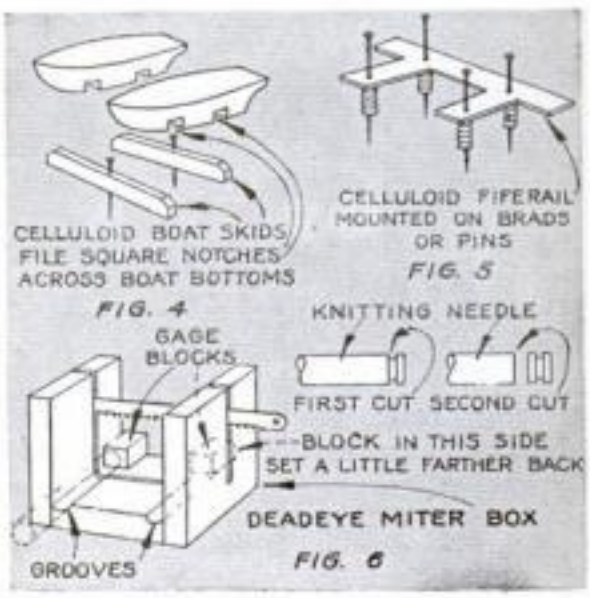


Fig. 4. Boats and skids. Fig. 5. A celluloid fife rail. Fig. 6. Miter box for cutting deadeyes.

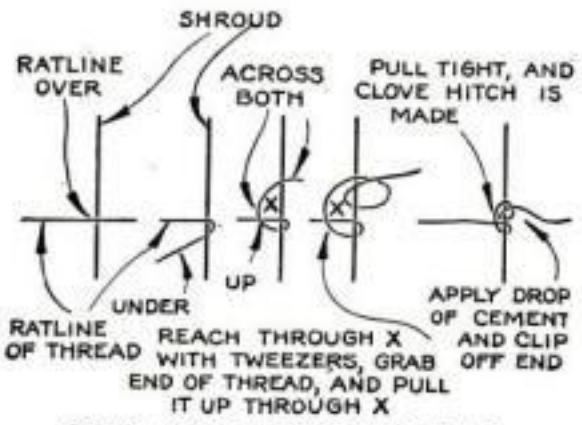
In setting up a celluloid fife rail, such as is shown in Fig. 5, at the foot of a mast, flat glass beads may be used to simulate the turned posts.

Celluloid knitting-needle deadeyes may be turned out quickly if the small miter box shown in Fig. 6 is used. The box has two 90° cuts into which a hack saw blade is placed. Along the inside of the bottom make a groove close to each side. A small block is tacked a little to one side of one

cut and is so situated that when the needle is held in the groove with its end against the block, the resulting saw cut is close to the inner end of the needle. Rotate the needle and saw lightly, making a groove around it. On the opposite side of the box, a second block of wood permits the needle to extend a bit farther beyond the groove, so that when in this side of the box the needle may be sawed off, and a grooved deadeye results.

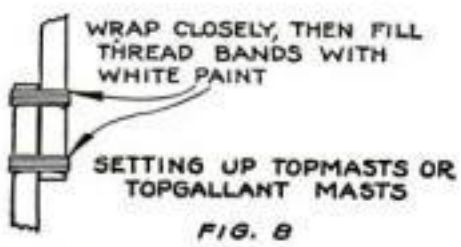
Ratlines which are simply glued on and clipped, or which are built up on the shrouds before mounting, can never equal the strength and finish of ratlines which are clove-hitched to the shrouds. If the two ends of a ratline are carefully clove-hitched to the shrouds, it will lie flat against the inside shrouds without being glued or laced alternately.

Tying the clove hitches is simplified greatly through the use of a pair of



TYING CLOVE HITCH ON RATLINE

FIG. 7



SETTING UP TOPMASTS OR TOPGALLANT MASTS

FIG. 8

Fig. 7. How to tie a clove hitch. Fig. 8. Imitating topmast bands with thread and paint.

tweezers (see Fig. 7). Pass the ratline completely around the shroud once; then, reach through the loop with a pair of tweezers and bring the free end up, thus completing the clove hitch. A drop of cement should be put on the knot, and when it has dried the free end may be clipped quite close.

In making masts, select a dowel whose length equals the sum of all the parts of the mast to be built up, and whose diameter is that of the foot of the mast. Clamp a small plane upside down in the vise, and draw the dowel over the plane until a fair taper, from the full diameter at one end to almost a point at the other, is obtained. Smooth with sandpaper and then cut the sections of the mast, starting at the large end.

On masts or sections which are too small to take a standard fitting, an imitation fitting can be made in the manner shown in Fig. 8. Spread a layer of cement around the parts to be lashed, wrap four or five turns of thread closely together in a single layer, tie the ends together, cement, and clip. When dry, give the threads a coat of white paint. Repeat the painting until the threads are well covered and the whole lashing is built up into a smooth

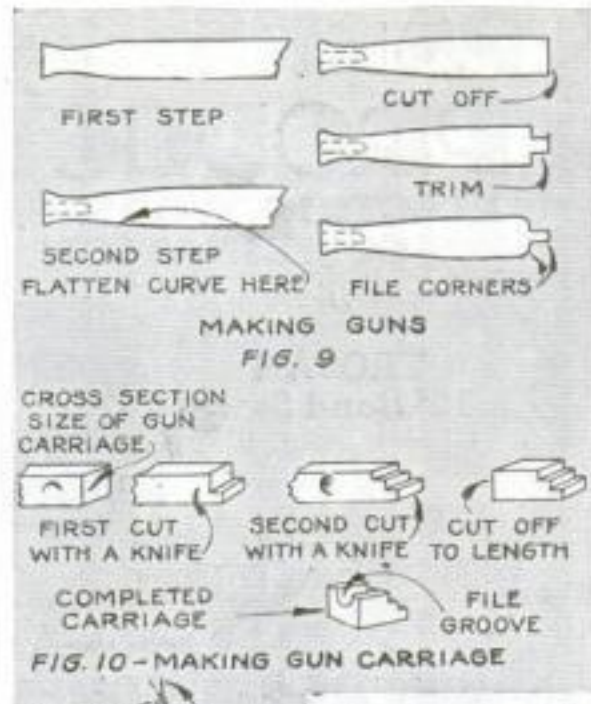


Fig. 9. Steps in making small cannon. Fig. 10, How the gun carriages are made. Fig. 11. A paper ensign which is doubled over the halyard and cemented.

band that resembles a genuine fitting.

Small cannon can be fashioned from dowel stock. Place a half-round file on the bench, round side up, and rub a piece of dowel over the file, turning it in the fingers at the same time until a shallow groove is made similar to the one shown in the first drawing in Fig. 9. With a flat file, taper back the inner end of the groove and drill a small diameter hole in the muzzle to represent the bore. Next, cut the dowel to the length of the gun plus the cascabel and trim the breech with a sharp knife. Smooth the edges of the breech and the cascabel with a spark plug file. Paint the gun black.

For gun carriages, choose stock whose cross section is equal to that of the gun carriage and with a sharp knife cut two notches as shown in Fig. 10. Next cut the carriage to the proper length and file a lengthwise half-round channel as deep as the radius of the gun. The carriages can be colored with a walnut stain. The guns are mounted in the carriages with cement.

Often a very fine chain is desired for use between gangway boards or similar places. Small eyeglass chains that come in a circular spring case are excellent for such purposes.

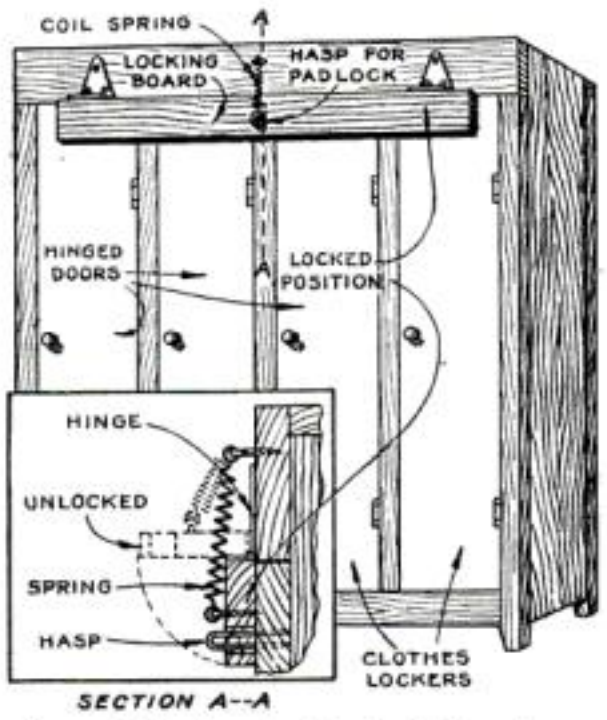
Small flags can be easily fastened to halyards if the flags are cut double as shown in Fig. 11. Fold a piece of paper and then cut out the flag. The appearance of stiffness can be avoided if the flag is cut in a wavy shape as illustrated instead of rectangular.

Draw or paint the design on each side. The blue-starred field of the American ensign is easily represented by painting vertical and horizontal lines of blue water color close together. Run cement on the inside surfaces of the double flag, place a thread in the end crease, and pinch the flag together until the cement sets. The result is a flag with a neat halyard.

CELLULOID objects such as spectacle frames and combs often can be repaired when broken by painting the butting edges with concentrated acetic acid and pressing them firmly together for a few minutes.

ONE PADLOCK FASTENS ROW OF LOCKERS

WHEN it is not essential to have individual locks for a group of lockers, the doors can be secured by a single board hinged across the top of the cabinet as shown and fastened with a



How a single hinged and padlocked board can be used to keep a group of lockers closed.

padlock. A coil spring raises the board when the padlock is removed.

This method of construction, which was recently used in a small machine shop, not only saved the expense of individual locks, but it allowed one man, in this case the foreman, to be charged with the sole responsibility for opening and closing the group of lockers.—ARTHUR KENDALL.

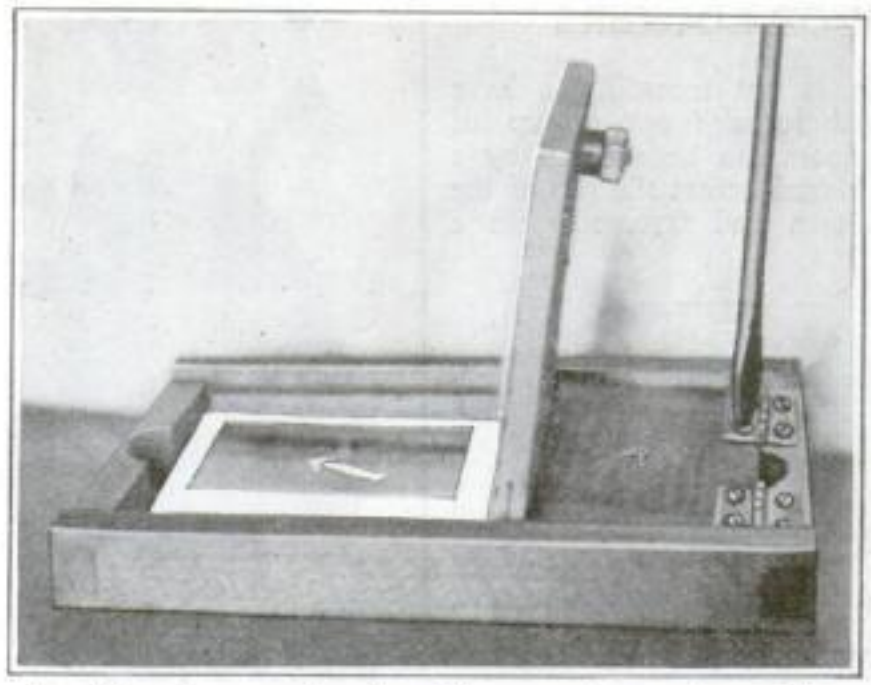
ANSWERS TO SHOP TEST

BELOW are given the correctly edited statements in the home workshop test on page 125. The wrong word or terms have been omitted in each case.

1. A hand tool used to cut threads in a hole or on an internal surface is called a *tap*.
2. The center terminal on a dry battery is *positive*.
3. *Auger bits* are graduated in 1/16 in. steps.
4. Lighting fixtures in the home are usually connected in *parallel*.
5. A No. 6 wood screw is *smaller* than a No. 10.
6. The priming coat of paint is applied *before* all holes are puttied.
7. The length of a flathead wood screw is determined by *the over-all length of the screw including the head*.
8. Varnish is thinned by adding *turpentine*.
9. The set of the teeth on a saw blade supplies the *clearance*.
10. In decorative metal work, the metal should be *annealed* before the hammering process is begun.
11. The portion of the step on which we walk is called the *tread*.
12. *Oil* stain will not cause the grain of the wood to become noticeably raised.
13. Go *across* the grain when rubbing off a paste wood filler.
14. In finishing, rottenstone and oil should be applied *after* the pumice stone and oil, since it cuts *less* rapidly than the pumice.
15. In mixing an outside white lead paint for new wood, the second coat should contain *less* oil in proportion to the white lead than the priming coat.

A definite program for getting ahead financially will be found on page four of this issue.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.



A printing frame may be adapted for use as the top of a printing machine by fastening the back with hinges and adding a knob.

Easily Constructed Electric Photo Printing Box

By H. BIDWELL

MOST amateur photographers have to be satisfied with an ordinary printing frame because the amount of work to be done hardly warrants the purchase of a so-called printing machine.

In its simplest form the printing machine is really nothing but an elaborate printing frame built as a permanent part of the body of the cabinet, inside which is placed the printing light. The only difficult part of a printing machine to build is the top. This difficulty can be avoided by starting with an ordinary printing frame and then building the rest of the outfit.

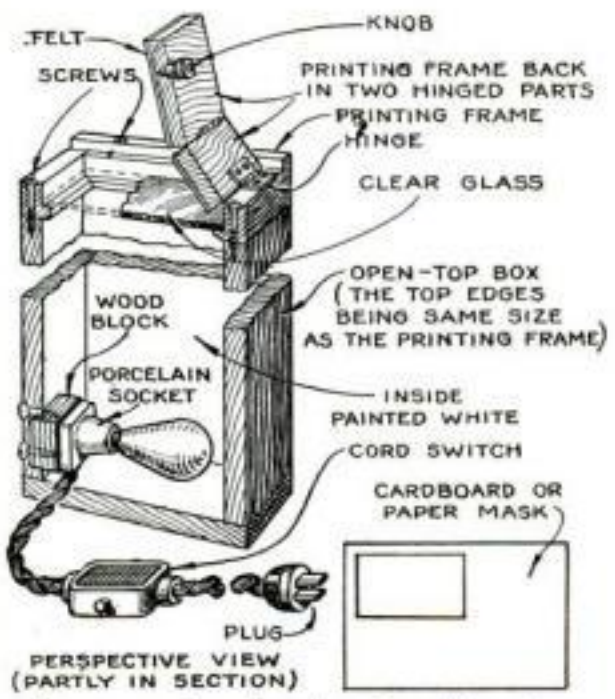
Assuming that you possess a 5 by 7 in. amateur printing frame, the first step in transforming it into a printing machine of the simplest type is to build a wooden box open on one end, with the open end the same size as the printing frame. The box should be at least 15 in. deep, unless you do not expect to make prints larger than 2¼ by 3¼ in. Prints as large as 4 by 5 or 5 by 7 in. are printed more uniformly if they are held at least 20 in. away from the light.

In ordinary printing with the frame held near an electric bulb, the unequal distribution of light does not show up because the printing frame is usually moved back and forth to get even illumination; but in the printing machine where the light is fixed, it is best to allow more space between the negative and the light.

Be sure that the open end of the box is absolutely square. Then fasten the frame over the opening, using wood screws. Because the wood of the frame is thin it is desirable to drill holes in the printing frame so that the screws will not jam in the frame and split it.

After the frame is fitted to the top of the box, place the back in position and lock the springs. Now take two small brass or iron hinges and fit them carefully to the top of the narrower leaf of the frame back, as indicated in the photograph. If the hinges are at all loose, place a piece of blotting paper underneath the leaf of each hinge which fastens to the printing-frame back. This will force it down more tightly against the negative. Next remove the two brass springs and fit a knob at the other end of the frame. This is used merely to lift the frame. If nothing else is handy, take a small piece of wood and fasten it by means of a screw. In the simple printing machine illustrated, an old radio binding post was used.

Paint the inside of the box white. On one side near the bottom, fasten a block of wood on which to mount an ordinary porcelain-base electric light socket. Place



A cutaway view showing the printing frame in place on the box, and the mask used with it.

the socket so that the bulb will be in a horizontal position and central.

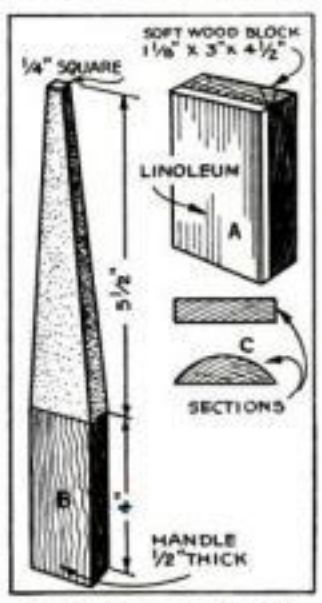
Connect a drop cord to the socket. Run it through a hole in the side of the box and connect in the cord one of the button or "through-cord" switches such as are often used on electric toasters. At the other end of the drop cord, fit a plug which can be attached to the electric light socket. A 60-watt bulb will be about right, but a smaller or larger bulb may be used if you desire slower or more rapid printing. For ordinary amateur work it is better not to use too large a bulb because the exposure, especially of thin negatives, will be so short that it will be hard to make it accurate. A small red light, independently operated, will allow inspection of the negatives for dust.

A suitable mask for your size film should be cut from paper, the outside measurements exactly fitting the opening of the frame. In one corner cut out a rectangle equal to the masked size of the negative. Locate this opening so that the strip of paper at the edge of the opening in the mask is equal to the width of masking you desire.

To operate, place the negative face up on the mask and slide it to the corner over the opening. Place the sensitive side of paper down over the negative. Pull down the frame and press it evenly against the negative while operating the switch.

AIDS IN SANDPAPERING

FOR sanding flat surfaces by hand, a sandpapering block should be used. One can be made as shown at *A* from a piece of whitewood or other soft wood 1⅛ by 3 by 4½ in. and a piece of plain linoleum a little larger than 3 by 4½ in. Glue the linoleum to the block under pressure and trim the edges when the glue is dry. The linoleum gives a fine resilient surface for sandpapering. The sandpaper is held over the block with the fingers—not attached in any way.



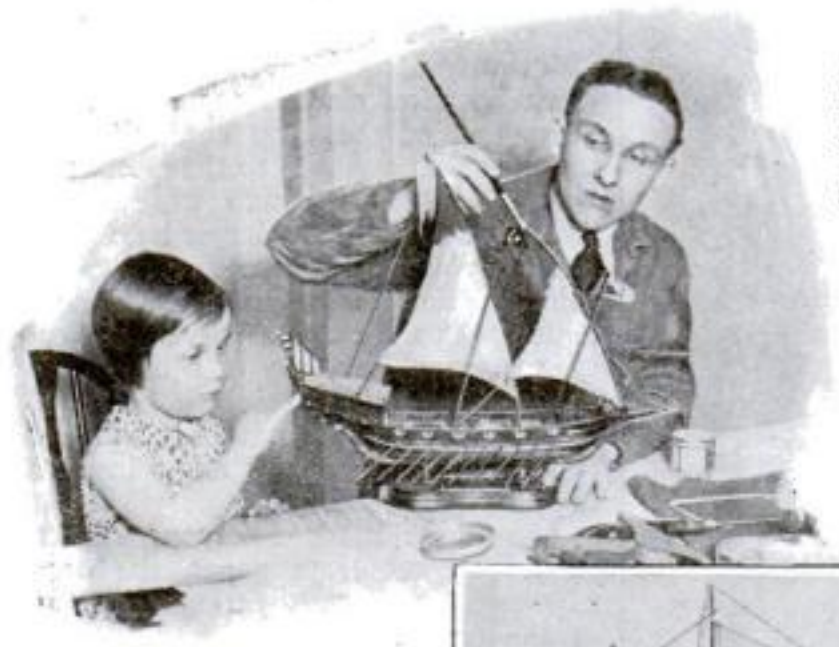
Sandpaper sticks can be variously shaped.

Sandpaper sticks made as illustrated at *B* will be found useful for trimming up mitered corners and bracket edges and for many other purposes. I make them of various grades of sandpaper, from No. 1 down to the finest; and in various shapes—square, flat, and round—as at *C*.

In gluing the sandpaper to the wood, see that the joint comes about the center of the flat part of the back of the stick. Emery sticks can be made in the same way.—J. S.

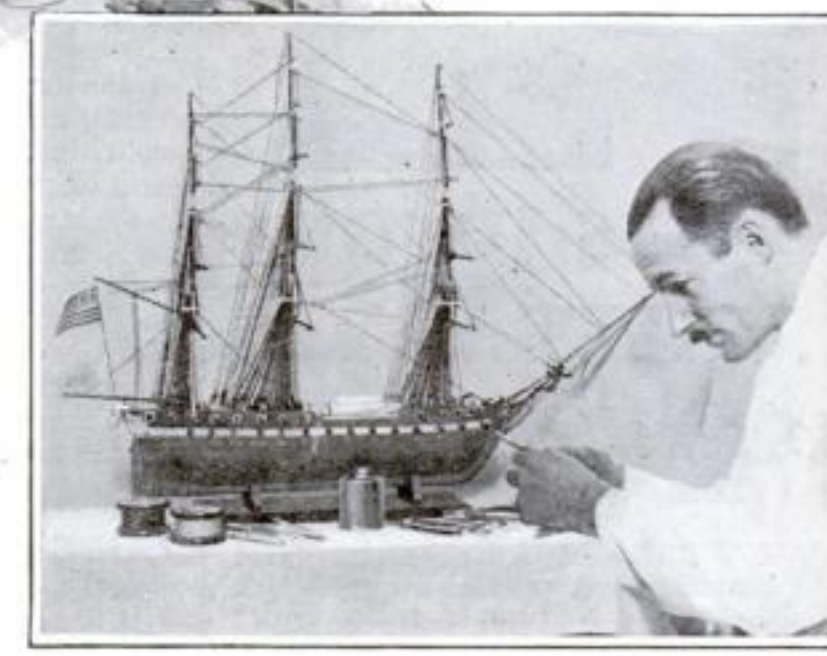
BEFORE being painted, new radiators or those in very bad condition should be given a coat of red lead and boiled linseed oil or other rust-inhibitive priming paint.

Home Workshop Honor Roll



Mr. Bodkin spent 223 hours completing this model of the Barbary pirate galley, which was made, to use his own words, "line for line from the excellent plans which you furnished me with in February."

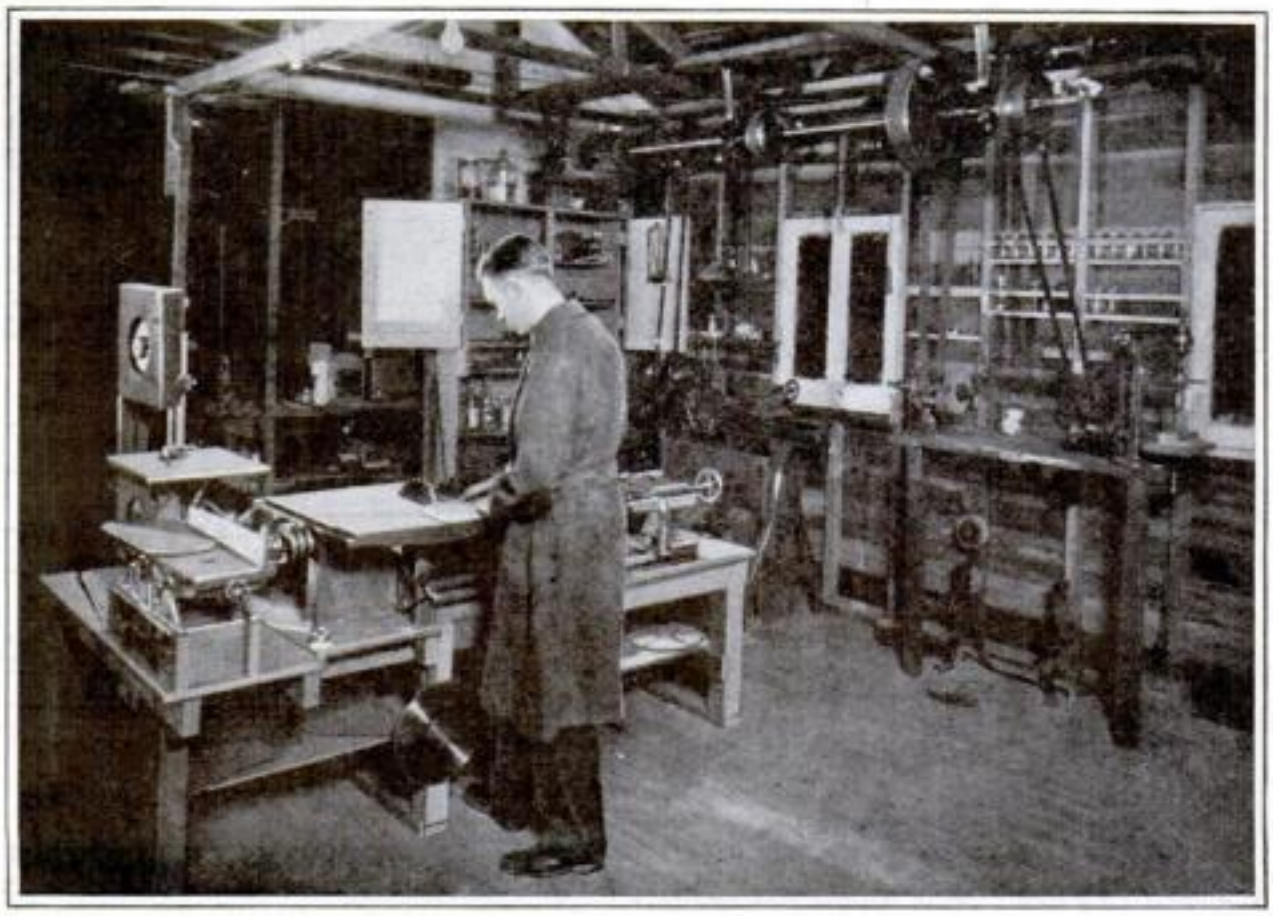
Surgical tools were used by Dr. Logan in the construction of the model of the *Constitution* ("Old Ironsides") illustrated below. Model making occupies most of his spare time between hospital cases.



FINDING that he had some spare time "between cases," Dr. Noble H. Logan, resident physician at the Oakland (Calif.) Emergency Hospital, took up the hobby of model making with the tools at hand—surgical instruments. He found that the delicate tools of the surgeon are excellently suited for building ship models. He has constructed two pirate galleys and a model of the *Constitution*, which is illustrated, and is now working on a Spanish galleon, all from the plans of E. Armitage McCann, POPULAR SCIENCE MONTHLY's ship model expert.

Harold T. Bodkin, of Chicago, who made use of POPULAR SCIENCE MONTHLY Blueprints Nos. 44 and 45 in building the Barbary pirate galley illustrated, writes that he considers the magazine one of the most valuable aids he has encountered.

The shop shown below is that of William C. Miles, of San Bernardino, Calif. It is particularly interesting because of the number of homemade woodworking machines it contains. Mr. Miles designed the machines, made the patterns, had the parts cast at a foundry, and machined what he could on his own engine lathe, finishing the larger parts in the shop of a public night school.



The drive shaft of Mr. Miles' woodworking outfit is equipped with an automobile transmission and flexible coupling so that different line-shaft speeds can be obtained. A ½-H.P. electric motor is used.

DAMP-PROOFING CELLAR WALLS IN COLOR

DAMP cellar walls, aside from being unhealthy, prevent the use of the basement for much else than a catchall for dust and an accumulation of old furniture, boxes, and rusted gardening tools. This condition, however, can be remedied in many cases merely by the application of a good grade of cement paint.

These cement paints, which should not be confused with either cold water or kalsomine paints, can be obtained in a variety of colors—cream, grey, green, blue, and white—and when properly applied will form a protective covering for the walls that will convert your cellar into an additional room—a workshop, smoking or billiard room, a playroom, or a room for a thousand and one other uses.

The surface to which the paint is applied must be free of dirt, white spots caused by efflorescence, and previous coats of cold water paint, kalsomine, and whitewash. If the surface is of some nonabsorbent type, cement paint should not be used.

After the surface has been thoroughly cleaned, wet it down and apply the first coat of paint, made by mixing the cement paint powder with water to the proportions suggested on the package.

The second coat is applied after the first coat has dried for twenty-four hours and has been thoroughly wetted with water. The second coat, as in oil paints, is thicker than the first and is made by decreasing the proportion of water to a given amount of the paint powder.

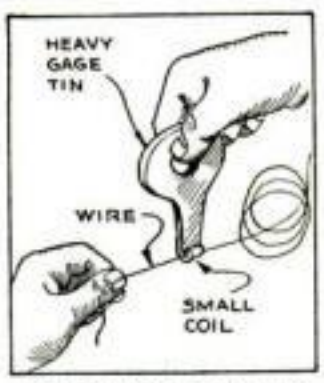
Apply the mixture with long strokes of the brush, keeping plenty of paint on the bristles at all times. A spray also can be used, if desired. In both cases, however, the paint should not be allowed to settle in the paint container but should be agitated frequently.

A thick paste, which can be made from the paint powder, will serve for filling any cracks in the surface.

Cement paints also can be used effectively on cement garden furniture, exterior walls, and swimming pools.

TOOL FOR STRAIGHTENING THIN PIANO WIRE

MANY builders of model airplanes have difficulty in straightening thin piano wire. Pliers, if not designed for the work, make a bungling job of it, so I devised the tool illustrated, which insures a neat job and incidentally saves time. A piece of heavy gage tin is cut to a shape resembling a small key and tapered off to a width of ⅛ in. or less at the end, where a very small coil is formed with round-nosed pliers. The wire is straightened by inserting the end in the coil and drawing it through.—WILLIAM MAPLE.



Taking kinks out of stubborn piano wire.

WHY MIDGET GOLF SWEPT COUNTRY

(Continued from page 23)

jokesters even tell the story that an attempt was made to buy a famous hotel, with the idea of razing it to make room for a miniature golf course. Several small fortunes have been collected by men who made a business of securing options on all land available for the purpose.

Two to three million people a day, and perhaps more, have been playing on these grounds. This means upwards of a million dollars in daily receipts.

Sales companies seeking buyers for sets have pictured an opportunity to make profits of $100 to $300 a day. Though probably not the general rule, there are many instances where this has been accomplished. Certainly many owners who had courses built as late as September counted on getting back their investments, plus substantial profits, before winter.

THE exact reasons for the enormous success of the fad are a mystery to everybody, including its promoters. It happened to fit in with some odd quirk that somehow existed in the tastes of a great many people at the same time. This is the most comprehensive explanation.

There are others more definite, but only partial. Miniature golf is one of the few games that can be played out-of-doors at night, but this fails to explain its popularity in the daytime. It gives the city dweller a chance to play in the open, without leaving the city; but Garnet Carter's first course was popular with men and women who had a full-sized golf links at their disposal.

It offers the average man who has never played golf the feeling that he is playing the game hitherto denied him by cost, inaccessibility, or other causes; yet Carter's course again shows there must be other reasons. Even the novelty of the game seems an inadequate explanation.

One indisputable factor in the business success of the little links is that passers-by can look and be interested. Location is of greatest importance. The profitable course always draws heavily on the audience outside the fence.

Crowds flocking to the miniature links have presented a problem to rival amusements, particularly in the smaller towns. A national theatrical newspaper, in a somewhat hostile review of the situation, reported that dance halls and pool rooms, and not theaters, had borne the brunt of the loss.

Skill and luck both govern the success of the player in his way around the links, and the requirement for both probably accounts for much of the fascination.

YOU get your club and ball at the caddy house, and are ready to play. The hazards vary, but most of them are comparatively simple. Water and sand form the natural obstacles, but to these are added hollow logs through which the player must shoot, steep inclines up which the ball must roll to drop into a pipe leading to the green, wooden wickets, sometimes as many as three of them in a row, barriers around the green over which the ball must be driven, and tunnels of various forms.

Freak or unusual hazards may be found on many courses, and on some the main difficulty lies in a sloping fairway or green, the slant of which is hard to see though heavy enough to throw the ball off its course. Some of the hazards, as the logs and tunnels and wickets, would never be found on a reg- (Continued on page 137)

WHY MIDGET GOLF SWEPT COUNTRY

(Continued from page 136)

ular course, but the water and sand troubles are familiar to all golfers.

Tom Thumb par is either forty-two or three, depending almost entirely upon the hazards. Usually there is no hole that cannot be made in one if the ball is hit correctly—and the player is lucky. Rarely is there a hole that justifies a par above two.

There are holes at which the number of strokes is limited, so that a poor player cannot block the course to those following him for too long. Many owners, too, change the hazards to make them easier and speed up play.

Installing a course properly calls for expert planning and careful workmanship. Standardized parts and designs make it possible to apply a general formula to improve the quality and increase the speed of construction, but this formula is modified to suit each individual course.

C. G. Mackintosh, construction engineer for the (Tom Thumb) Rochester organization, explains the details of his work on a typical course.

"FIRST, a special plan has to be drawn, to suit the lot itself," he says. "The holes have to be arranged so that if a ball gets off the fairway, it won't interfere with the play of others. That is especially so with the curve shot and the jump board shot. We try to locate them in corners, or against walls. Then if a player hits too hard, he won't strike anyone else.

"We plan the location of the fence, the light poles, and the caddy house.

"The first actual work is to get the ground into good condition. It is cleared of rubbish and a good general grade is established. Then I mark out on the ground the exact location of all the greens and fairways.

"Then we are ready to start placing the equipment. Our sets come from the factory in about one thousand pieces. The total weight of a shipment is something like ten thousand pounds.

"The first things set out are the pipes that are to inclose the greens and fairways.

"We have about fifteen men working on the job at one time, and a crew of four attends to putting out these pipes, with the anchor joints that are to hold them steady. If a slope is called for, the boundary pipes are set at the exact angle. This is checked by measuring the height of the pipe at each end, from the level ground.

"Another crew excavates the ground to a depth of six inches or a foot below the level of the pipes. There are some fairways which are to have elevations, and the ground is built up at those points.

"A FILLING crew begins work on the excavations as they are completed. First a layer of rock is put in. It is rolled and tamped. Then a layer of cinders goes down. The cups are fitted into this layer, and the cinders are rolled and tamped tightly. Then the cottonseed hull compound is spread on top of the cinders, and rolled and tamped.

"The filling materials extend out slightly from beneath the pipes, and these edges are sodded.

"Walks are laid, and on many courses covered with stone dust. Sometimes there are special sand traps beside some of the fairways, or natural hazards, making use of large stones, trees, or terraces. The better courses often have shrubbery or more elaborate landscaping.

"For the aver- *(Continued on page 138)*

WHY MIDGET GOLF SWEPT COUNTRY

(Continued from page 137)

age course, we figure about six days for installation."

The materials used by independent builders, in laying out their links, vary widely. Many of them, instead of being built on natural earth, are constructed on cement paving painted bright green. Instead of the patented cottonseed hulls, numerous other substances are being employed, including clay, sand, fibers, asbestos, ground seaweed, and cork. Felt factories are producing special thick felts for the purpose.

Dozens of industries have been stimulated by the demands for materials for the miniature courses. Lumber, metal, and wire go into the construction of fences and other parts. Canvas and duck are used for gay umbrellas and awnings. Equipment and electricity are used in large quantities for lighting.

FOR teeing grounds, from which the first shot is made at each hole, various courses use doormate of fiber or rubber. The sale of golf clubs has been tremendous. One nationally known sporting goods house estimates that 100,000 putters were sold to the miniature courses this season, increasing the total sales of this type of club by about forty percent. Figuring the number of courses as 25,000, the estimate of 100,000 clubs is seen to be extremely conservative.

The number of balls used is beyond accurate estimate, but every new course installed by the Rochester concern is given six dozen balls to begin business.

It is natural that all the people directly or indirectly connected with the business, as well as the actual owners of the $75,000,000 worth of commercial courses, are chiefly interested now in its prospects of survival. In spite of the mystery around its tremendous appeal and growth, certain definite conclusions concerning its future are clear.

Men who have studied it are agreed that some of the poorer built or badly located courses, once they are closed for the winter, will not be reopened. Many of them have already returned their owners' investments, with good profits, and the owners will hesitate to risk their gains on the reconditioning that will be necessary.

EITHER decreasing trade or an increasing number of courses is bound to stiffen competition. Price cutting may be one result.

Efforts probably will be made to maintain and heighten public interest, by new hazards. Like clothing, or automobiles, miniature golf links will be given new "styles" to attract customers.

On a California course, and in Flushing, Long Island, two courses achieved what is probably the extreme in freakish obstacles. This is a live bear cub in a cage. Players putt their balls through the cage, and if the bear is in a playful or antagonistic mood he tries to stop them.

In some cases course owners have hired orchestras to attract and entertain players; others have installed radio receiving sets, many promote contests and offer prizes.

Recently the Tom Thumb courses were organized for a national tournament. Contests were sponsored locally by newspapers, and the winners in districts and states are scheduled to meet this month for a National Open tournament, on the original course on Lookout Mountain.

Whatever happens to the weaker units in the new business, it seems certain that it will continue to thrive for several years.

RADIO NEEDS YOU!

Radio Inspectors $2000 to $4500 a Year

Radio Broadcast Mechanics $1800 to $4800 a Year

Radio Operators $90 to $200 a Month (Board Free)

...and YOU Need Radio!

Many opportunities for service men, mechanics, radio operators for ship, shore and broadcast stations

MANUFACTURERS and broadcasting stations are seeking trained RCA Institutes men. Millions of sets need servicing... thousands of ships require experienced operators... Never before was there an opportunity like this.

The Only Radio Course Sponsored by Radio Corporation of America

RCA Institutes (A Division of Radio Corporation of America) conducts courses in every branch of Radio and assists graduates in obtaining employment. Why wait another day... See for yourself what Radio will do for you...

Study Radio under the direction of RCA ... the organization that sets the standards for the entire radio industry... Study under the direction of RCA experts... Learn the "why" as well as the "how" of radio problems... by actual experience with the remarkable outlay of apparatus given to every student.

Graduates of RCA Institutes Find It Easier to Get Good Jobs

Students of RCA Institutes get first-hand knowledge, get it quickly and get it complete. Success in Radio depends upon training and that's the training you get with RCA Institutes. That's why every graduate of RCA Institutes who desired a position has been able to get one... usually in from three to ten days after graduation. That's why trained graduates are always in demand!

Study Radio at Home in your Spare Time

Increase your earning capacity by learning Radio under the direction of RCA experts.

Ask about amazing outfit of special radio equipment supplied to every student of the RCA Home Laboratory Training Course.

See for yourself how you too can tune-in on success by studying Radio in your spare time.

Study Radio

by taking Radio Study Course at any of these RCA Institutes resident schools (classroom instructions)... RCA experts instruct you in every phase of radio... The man who trains TODAY will hold down the big-money job of the future.

RCA Institute resident schools that give classroom instructions are located in the following cities:

New York
75 Varick Street
Boston, Mass.
899 Boylston Street
Philadelphia, Pa.
1211 Chestnut Street
Baltimore, Md.
1215 N. Charles Street
Newark, N. J.
560 Broad Street
Chicago, Ill.
222 North Bank Drive

Send for
FREE BOOK

...Or step in at any of our resident schools and see for yourself how you too can quickly place yourself upon the road to success in Radio... how you can speed up your earning capacity... earn more money than you have ever earned before. Come in and get our FREE BOOK or send for it by mail. Everything you want to know about Radio. 40 fascinating pages packed with pictures and descriptions of the many opportunities in this fastest growing industry of today.

Send for Free Book Today!

RCA INSTITUTES INC.

A Division of Radio Corporation of America

RCA INSTITUTES, Inc.
Dept. PSM-11, 75 Varick Street, New York

Gentlemen: Please send me your FREE 40-page book which illustrates the opportunities in Radio and describes your home laboratory methods of instruction.

Name.....

Address.....

.....

Occupation.....

RADIO AIDS POLICE

(Continued from page 21)

moved from a downtown building, where it was subject to various kinds of interference, to Belle Isle in the Detroit River. An improved receiving set was devised for the cars, with the aerial concealed in the top and the apparatus housed in a compact steel box. Under varying conditions, the new equipment was tested and found satisfactory.

Shortly after, when about forty radio-equipped machines were operating successfully in Detroit, Cox was "loaned" to Chicago to install equipment in 142 police autos. These replaced motorcycle sidecars and had gun and ammunition racks built back of the front seats ready for instant use. Batts went to Indianapolis on a similar mission. Meanwhile other large cities had been making police radio experiments. Seattle, Wash., added ten "prowler cars," radio-equipped, to its crime fighting armament and Cleveland, Ohio, and its suburbs, installed thirty-five more.

AT first, the work was hampered by the reluctance of the Federal Radio Commission to license police broadcasting stations. While the early alarms sent out through regular radio channels resulted in some help from amateur detectives who listened in, it also had its disadvantages—as witness the experience of Lieut. Walter Storms and his companions in one Chicago radio car.

A woman reported to police headquarters that a burglar was looting an apartment across the street. Station WGN sent out a general alarm to all squad cars equipped with radio. When Storms ended his dash to the apartment, he found the robber gone. In one corner the radio was going full blast and under its lid was tucked this note: "Dear Radio Man: Thanks for the tip-off. You're a swell announcer. I'm signing off now."

There is another reason why broadcasting alarms through regular channels is unsatisfactory. Soon after Detroit began experimenting with radio cars, a police official, walking down a side street, was amazed to hear the honeyed strains of a popular dance tune coming from a parked police automobile. As he peeked around the back of the car, one member of the crew, huddled around the radio, was saying: "Now let's get Chicago!"

To prevent crews from listening to Amos 'n' Andy instead of headquarters, modern police sets are made so they can be tuned in only on the home station.

In Detroit, two types of radio-directed police cars are used. The Cruisers are high-powered seven-passenger machines carrying four men armed with revolvers, automatics, shotguns, and tear-gas bombs. The Scout cars are light, speedy machines with a crew of two men.

FREQUENT test calls are sent out to the roving cars to be sure the sets are working properly and ready for an emergency. If no message comes through for fifteen minutes, the crews are required to call headquarters on the telephone and report the fact.

"Trouble-shooting cars" are always on hand to speed to a police machine when its set has gone dead. When crews are changed, the radio equipment of every car is carefully inspected by experts. In other cities, similar precautions are taken.

What is probably the most elaborate radio-car equipment in the world is operated by Scotland Yard, in London, England. Sixty powerful machines were specially built for its use. Some resemble furniture vans, others are camouflaged *(Continued on page 141)*

RADIO AIDS POLICE

(Continued from page 140)

as vegetable trucks, doctors' coupes, or luxurious limousines with liveried chauffeurs and passengers wearing silk hats.

Each machine is manned by a crack speed driver and a picked crew. At the first signal flashed from the metal-lined wireless room at the top of the Yard, these roving machines are capable of roaring through Piccadilly, the Times Square of London, at seventy miles an hour, if necessary.

When Lord Byng took command of Scotland Yard, a few years ago, one of his first steps was to build a radio station for broadcasting fingerprints. A similar station in Berlin, Germany, the other day, flashed fingerprints of a wanted criminal 7,500 miles to Buenos Aires, in South America.

SINCE radio has taken a regular place in aiding officers of the peace, first-hand evidence of crimes has been easier to obtain. The split-second arrests catch criminals red-handed. Circumstantial evidence does not have to be used in trials and speedier convictions result.

Former Police Commissioner William P. Rutledge, of Detroit, says that convictions have increased nearly twenty percent since the adoption of radio police cars. The squads are able to swoop down upon bewildered lawbreakers, striking like lightning out of a clear sky, preventing them from destroying evidence.

An example of how such a quick arrest preserves valuable evidence is found in the recent cleaning up of a Detroit murder case. A few weeks ago, a frantic telephone call to headquarters from an outlying district reported a brutal murder. An immediate alarm was broadcast.

Cruiser No. 32 picked it up not far from the scene of the crime. In two minutes, the killer was arrested just as he was about to throw his gun into a near-by creek. But for the radio, the officers would have arrived after this important piece of evidence had disappeared.

What goes on behind the scenes when a spectacular "radio arrest" is made? At the Detroit headquarters a dispatcher is in direct communication at all times with the police broadcasting station WCK on Belle Isle, two miles away. When the report of a crime comes in by telephone, he presses a button. A red light flashes at WCK. Out of a loud-speaker comes the message from the dispatcher. An announcer immediately repeats it into a microphone. So sensitive is the receiving mechanism in the cars that frequently the crews can hear the dispatcher himself and start on the run before the announcer begins to relay the order.

WHAT they will find at the end of the run, the crew rarely knows. The riders of a radio car must be prepared for anything. Not long ago, one machine raced through traffic to a Detroit address. The officers were met by a frightened gentleman who said he heard a strange ticking and feared the house was going to be blown up by a time bomb. They investigated and discovered a clock under a pillow in his son's room where the boy had put it so he wouldn't miss hearing the alarm.

Another time, a Cleveland radio-car rushed to a corner where a "holdup" was reported. The crew leaped out and found a man pacing up and down the sidewalk.

"Did you call the police?" the leading officer asked. "Where's the robbery?"

"I don't know anything about a robbery. I asked for an ambulance. But come on anyway."

The man dashed (Continued on page 142)

RADIO AIDS POLICE

(Continued from page 141)

up the steps of his house. A moment later, the officers emerged carrying his wife to the car. A record run was made to the hospital. Two minutes after the mother was admitted, a baby boy was born. In their appreciation, the parents named it after the sergeant in charge of the squad.

One of the most valuable jobs the radio-police car is doing is in recovering stolen automobiles. In eight months, eighty machines were recovered with its help in Indianapolis. The value of stolen property thus recovered was valued at $65,000. In Dallas, more autos are recovered each month than are reported stolen. The answer to this apparent paradox is that many machines stolen in other cities are recovered there.

BOTH short-wave and long-wave broadcasts are made to the Dallas police. The short-wave announcements go to police and firemen; the long-wave ones to the public as well. Many citizens jot down the numbers of missing cars and aid the police in their recovery.

Dallas policemen and detectives are required to listen to police broadcasts when they are off duty. This eliminates the necessity of twice-a-day meetings and the printing of hundreds of orders and messages. In Detroit, short-wave transmission is used exclusively.

The State Police of Pennsylvania operate five broadcasting stations, hooking up the widely-separated barracks with the headquarters at Harrisburg. Besides this, 213 police barracks and stations are linked together by an extensive teletype system, the electric typewriters being operated from a central sending station. In Seattle, the new $6,000 broadcasting station is used jointly by the police and fire departments. It was recently licensed by the Federal Radio Commission.

This commission, because it feared that interference might result, has turned down the requests for a number of police radio stations. It also has ruled that the power of such stations must depend upon the size of the city.

A community under 100,000 population can use only fifty watts. From 100,000 to 200,000, the limit is 100 watts; from 200,000 to 300,000 a 150-watt station is the maximum. The scale ascends until the largest cities are allowed to use 500 watts. That is the absolute limit. According to Kenneth R. Cox, the Detroit police-radio expert, 150 cities, at least, will require individual sending stations in the near future.

Even the lowest-powered stations carry the alarms far beyond the outskirts of a city. In many places, the county police and sheriffs tune in regularly. In one case, such coöperation resulted in a spectacular capture.

A PAIR of St. Louis bandits dropped down into Texas for "a little easy picking." They robbed a large pharmacy, escaping in a fast motor car. Dallas police headquarters broadcast a description of the crooks and the car they drove. In his office at Durant, Okla., Sheriff Rural Taylor picked up the report. He drove a few miles out of town on the main highway from Dallas to Durant and waited.

Three hours afterwards, a fast roadster screeched to a stop where Sheriff Taylor's car blocked the highway. The two thugs found a menacing gun leveled at them. They surrendered and seven hours after the broadcast they were back in Dallas—behind bars.

Such quick apprehension of criminals is one of the most effective checks upon law-breaking, officials *(Continued on page 143)*

RADIO AIDS POLICE

(Continued from page 142)

in cities where radio-cars have been installed report. In most of these cities the crime chart has taken a distinct downward trend since this latest air weapon increased the chances of the wrongdoers being caught.

Radio-directed police frequently arrive in time to nip crimes in the bud. Seven times in two weeks, Detroit machines reached the spot in time to prevent burglaries by the arrest of prowlers.

Two of the most spectacular feats recently accomplished by crime-fighting radio were the breaking up of the "Green Sedan Gang" in Detroit and the capture of the "Yellow Dog Bandits" in Cleveland.

OVER a period of several weeks, four men in a green sedan staged a series of daring holdups in the Michigan city. After each crime the green phantom car seemed to disappear. Finally a tip came to headquarters that the machine was parked in front of a barber shop. When the alarm was broadcast, the crew of one of the police cars picked it up near the spot and closed in on two of the stick-up men as they stepped from the door.

When they appeared in court an alert attendant saw one of the spectators trying to signal to the prisoners. He was arrested and later told where the fourth member of the gang could be found. A radio-car arrived just as this last gangster was preparing to leave the city. All four of the bandits were sent to the penitentiary for long terms.

In Cleveland, two armed thugs made a spectacular raid on the Ivanhoe branch of the Cleveland Trust Company. They escaped with all the money in the cashier's cage, dashing away in a touring car with a little yellow dog riding in the back seat.

Five minutes after the alarm had been broadcast, radio-car squads numbering fifty-five men were on the trail. The abandoned car was found in a gully outside of the city and the two men, still accompanied by the yellow dog, were caught in the fields beyond.

Today, crime rides in high-powered automobiles and escapes down paved highways. Seconds are precious to officers of justice. Seconds, not minutes, now determine the difference between escape and capture for the modern criminal. A five-minute head start means a cold trail to follow. The radio-car is the modern weapon that enables the police to cope with the modern criminal.

In Michigan, banks are now being supplied with direct telephonic communication to the state broadcasting station at Lansing. The instant one of these institutions is robbed in any part of the state, this station will spread an invisible net of radio waves to snare the criminals.

In the not-distant future, former Detroit Police Commissioner Rutledge prophesies, the next step will be taken. The whole United States will be linked by police wireless so that in the event of a major crime every police station and sheriff's office in the country will receive the warning simultaneously. Radio has joined the police force and is making good.

ASBESTOS-FILLED PLUG WILL NOT BURN OUT

CONSISTING of a metal casing filled with asbestos or other fireproof material, a new electric plug, recently placed on the market, is said not to burn out. The inside of an ordinary plug usually is made of treated wood.

RADIO AIMS AT REMOTE CONTROL

(Continued from page 79)

the upper right-hand corner of the set chassis. The right-hand motor operates the control. The cord belts connecting the motors with the set controls are quite clear—each with a spring operated idler pulley to take up the slack in the belt.

The system just described gives complete remote control but it does not give automatic tuning. The station must be tuned in each time as though you were operating the dial on the radio set itself.

Another system, that combines the feature of complete remote control and full automatic tuning, is shown in the diagram of Fig. 2.

IN this system, as in the one first described, there is a transformer *T* of the step-down type to supply current to the dial tuning motor *M*. This motor is of the standard, three-pole armature, series-wound type used to operate model railway locomotives. No changes are made in the armature, but the field coil is rewound in a special way. Instead of a single continuous winding on the field coil, the coil is tapped at the center.

This arrangement of the field coil winding reduces the power output of the motor, but as it has to develop only a small amount of power anyhow, the loss in power is not important.

The object of winding the field in this way is to make it possible to change the direction of rotation of the motor by changing only one contact instead of several as ordinarily required.

One terminal of the output transformer is connected to one of the motor brushes. The other brush is connected to the field coil center tap.

On the condenser drum dial *D* there is fitted a special two segment commutator *D1* and *D2*. At opposite sides of the commutator *D*, at points representing the bottom and top of the tuning range, there are two limiting contacts, *X1* and *X2*. There are, in addition, a number of other station contacts pressing against the commutator, each one adjustable around the circle so that it can be placed at the exact point where a given station is found. Each one of these extra station contacts is wired to a separate contact on switch *C*.

The motor is, of course, geared to the dial *D* by reduction gearing giving a very considerable reduction.

WHEN arm *C* is connected to the contact in the position shown in the diagram, current flows from the transformer, through the contact *C* to the station contact on *D1*, and so to *X1* and back through the motor *M* to the transformer. When taking this path, the current goes through part *M1* of the field coil, and the motor consequently rotates in a clockwise direction. *D* rotates until the slot shown at the bottom in the diagram reaches the station contact. The gap between the two segments cuts off the current and the motor stops at that point. If it should be turning so fast that it coasts past this point and so allows the station contact to ride over onto *X2*, the current immediately flows through the motor again but this time through the section of field *M2*. The motor consequently rotates in the opposite direction. It will therefore jiggle back and forth a couple of times just as though the dial were being tuned by hand and eventually come to rest at exactly the right point.

A careful study of the diagram will show you that no matter which contact is touched by the arm *C*, the dial *D* will be rotated so that the break in the commutator segments of *D* will be directly opposite the station contact selected. Of course the construction must be such that the lower gap in *D* is a trifle wider than the station contact.

When either of the extra buttons *C2* and *C3* are pressed, the motor rotates in one way or the other without regard to the special station contacts. These buttons are used for finding stations in between the points to which the apparatus automatically tunes.

The cable between the remote control box and the set must necessarily carry all of the wires to the different contacts, and so on.

IN another form, this same system is made with a separate button for each station contact instead of using a contact arm working on a row of contacts. When buttons are used it is simple to use as many remote controls as desired as with the system first described.

This same system is also built with a special motor so constructed that the armature is held out of line with the pole pieces by a light spring. When the current is turned on, the armature is pulled into line with the pole pieces and in that position operates a tiny cone clutch. Of course, the instant the current is shut off the spring pulls the armature back and thus opens the clutch.

With this arrangement, the motor does not run by the proper point, and distant stations are more easily located.

In many of these remote control units, there is a special switch which cuts out the loudspeaker while the control is in operation. This is not necessary, but it does prevent the sudden blare from different stations as the dial passes their tuning points.

If you desire to experiment with the construction of a remote control for your own set, I would recommend the arrangement shown in Fig. 2. Aside from the fitting of the gearing or belts and pulleys and the construction of the special commutator *D*, which can easily be made from a sheet of brass or aluminum, the only other job except the wiring is to rewind the field of a small motor so as to get a tap at the center of field coil.

AUTO LETTER CONTEST PRIZE WINNERS

The judges decision in the contest announced on page seventy of the August POPULAR SCIENCE MONTHLY is as follows:

FIRST PRIZE—$75
D. C. Marshall, Manhattan, Kansas

SECOND PRIZE—$25
Gilson Willets, San Francisco, California

FIVE PRIZES of $10 each
Ellis J. Bardsley, New Britain, Connecticut
Arthur Cromson, Ottawa, Ontario, Canada
Wm. C. Gardner, Clover Lick, W. Virginia
John P. Picco, San Francisco, California
Fred C. Savage, Charleston, West Virginia

HONORABLE MENTION:
Akana, Francis K., Kailua, Hawaii; Bentley, Cyril E., Macon Ga.; Bernhard, E., Rock Island, Ill.; Bowen, Charles, Cincinnati, Ohio; Bulen, Leon L., Missoula, Mont.; Butts, Heber, Nashville, Tenn.; Cameron, A. H., Wichita Falls, Texas; Carveth, T. H., Montreal, Canada; Coakley, Frank N., Buffalo, N. Y.; Elliott, Charley R., Gueydan, La.; Ellis, J. S., Scranton, Iowa; Fassitt, Mrs. J. B., Rising Sun, Md.; Godfrey, Harry M., Mingo Junction, Ohio.

EXPERT ADVICE ON AUTO LIGHTING

(Continued from page 80)

"That's the way of it," Gus agreed. "Trouble is, lots of people don't realize that a generator couldn't charge a storage battery at all if it didn't produce a voltage higher than the battery voltage. As long as the battery is connected to the generator, the voltage can't get higher than the battery voltage. The flow of current through the battery takes care of that. If you stop that flow by spoiling the ground connection, up goes the voltage, and that means good-by to the light bulbs.

"Why don't you polish these headlight reflectors?" Gus observed as he opened them to replace the bulbs.

"I thought you couldn't polish them without spoiling the surface with scratches."

"YOU can't make them as good as new," Gus admitted, "but you can increase the light on the road a whole lot. Wash the polished surface gently with soap and water to get rid of the dust and grit. Then polish them with a high grade silver polish and a piece of old, well-washed linen. An old handkerchief that has been through the laundry till it's 'most falling apart is just the thing. Remember to take your time and rub the surface very gently. Don't scrub it."

"Thanks for the tip," said the car owner. "I'll take a bit of time off next Sunday and see what I can do."

"Too bad I can't put thirty-two-candlepower bulbs in these headlights," Gus observed as he inserted a pair of the usual twenty-one-candlepower size. "Some of the new cars have lamps approved for use with thirty-two-candlepower bulbs, and, believe me, they sure do light up the road!"

"I didn't know more than twenty-one candlepower was legal anywhere," the other exclaimed. "I should think larger lamps would cause too much glare."

"Not a bit of it," said Gus emphatically. "A thirty-two-candlepower bulb in a headlight that's made right, aimed right, and focused right glares less than a three-candlepower bulb might in a headlight that was all out of whack.

"IT'S the latest thing to use bigger bulbs everywhere in the car's lighting system. You'd be surprised how much better it is to use a fifteen- or twenty-one-candlepower lamp in the dome light, for instance. You don't have the dome light on while you're driving anyhow, and when you stop, it's fine to have plenty of light while you're getting in or out of the car. Another place where a bigger bulb certainly is worth while is in the stop light. I'll put a thirty-two-candlepower bulb in your stop light and the fellow behind is sure to see it even in the daytime."

While he was talking, Gus had been working the brake pedal slowly back and forth. "It's so dim I can't tell whether it's on or not from here. Is it working now, Joe?"

Joe stepped around to the back of the car. "It's lit now—no, it just went out," he said.

"I thought so," Gus grunted. "A stop light oughtn't to light until the brakes begin to take hold. This one lights the minute your foot touches the pedal. Plenty of drivers keep their feet on the brake pedal most of the time when they're in traffic. When the stop light is fixed like this it's always flashing on and off without really meaning anything. After it flashes a few times, without the car slowing down any, the fellow behind gets careless. Then, when the brakes really go on, he doesn't heed the warning. Want me to fix it right?"

"Go to it!" the car owner smiled. "Next time I stop here I'll let you talk first!"

RESCUE TANK MAY END "SUB" DEATHS

(Continued from page 41)

feet, where the pressure is the heaviest a human being can stand, and safely reach the surface with the "lung."

To approach actual conditions as closely as possible, the tank will be filled with salt water, the salinity of which will be the same as that of sea water. It will, however, be heated artificially, so as to safeguard the health of the men who must use it for long periods.

Leading down about fifteen feet from the top are iron ladders. In the first stages of the course, the men, equipped with "lungs," will stand on these to learn to breathe under water. Rung by rung, they will step down until they are from eight to ten feet below the surface.

Air locks, through which the men may enter the water in the tank just as sailors entrapped in a sunken sub would get into the open sea through an escape lock, are placed at eighteen and fifty feet from the top. How, with the aid of these locks, the men will be taught to escape from shallow depths was explained to me by Loughman in this way:

BY MEANS of a spiral stairway outside the tower, a small group of men enter the lock, closing the outer door behind them. They let water enter the lock by opening a flood valve. As the water flows in, the air inside the lock is compressed until the air pressure is equal to that of the water at the point where it enters the lock.

Now the door leading to the inside of the tank (representing the sea) is opened, permitting the water to rise to the top of the door opening. Above this level there remains an air space in which the men hold their heads to breathe. When they are ready to go, they pass a buoy, with a line attached, out into the water. As the buoy floats up to the top of the tank, the men fasten the line near the lock's entrance to the tank and use it to slide up to the surface.

Every ten feet the line is marked, so that the men know at what distance they are from the surface and can stop at intervals to "decompress" themselves—in other words, let the effects of the pressure wear off. This protects them against "bends" or caisson disease. The lock at eighteen feet will be used to teach the men how to handle the "lung" and lock. That at fifty feet will be for "decompression" training.

Loughman then showed me what is, perhaps, the most unusual feature of the "rescue tower." This is a dummy submarine at the bottom of the tank. Here a regular submarine compartment, eighteen feet long and twelve feet in diameter which, like the locks, is entered from the outside, has been built. It is equipped with a standard hatch and escape lock. As soon as men, entering it, close the door, they find themselves in virtually the same situation as members of a submarine crew trapped in one of its compartments at the bottom of 100 feet of water.

A steel collar or "skirt" around the hatch opening in the top of the dummy "sub" extends a few feet down into the compartment. When the men are ready to "escape," they unlock the hatch, which is kept shut by the water pressure. Then flood valves are opened, and the water rushes into the sub, compressing the air until it lifts the hatch open. The water is allowed to flow in until it is level with the bottom of the "skirt." Above this level, as in the case of the locks, an air pocket is left in which the men hold their heads while releasing the buoy, fastening the line, and donning the "lung." Then they slide up to the surface on the buoy line.

SAVING RUNAWAY FARM LANDS

(Continued from page 60)

until a few years ago, little practiced by American farmers except in the southeastern states, but it is now spreading rapidly in other parts of the country. Many types of terracing machines have appeared on the market, demonstrations and short summer courses in terracing are held at the agricultural colleges, and the need of such protection for hilly farms is beginning to be recognized by bankers in connection with farm loans. The Federal Land Bank at Houston, Texas, now carries a clause in its contracts on land loans requiring the owner to protect his fields by terracing wherever washing is likely to exceed a certain limit. If the farmer does not know how to do such work the bank sends an expert to show him. Last year, terracing was done in thirty-one states. Texas led with more than 574,000 acres terraced; Mississippi was second with 155,000 acres.

THE control of sheet erosion goes far toward the prevention of gullying. When gullies form, several methods may be used to fill them or to prevent them from spreading. The commonest mode of controlling gullies, when they are too large to be filled with the plow, is to build a series of "soil-saving" dams across them. These obstructions retard the flow of water, permitting the deposit of the silt carried by it and thus gradually filling the gully. They may be built of brush, straw, loose stones, or other materials that permit the passage of water, or they may be water-tight structures of earth, masonry, or concrete, in which case the water is carried around or under the dam by conduits or over it through a spillway. Trees, grass, honeysuckle, and other kinds of vegetation are often planted to protect the banks of gullies.

An ingenious form of soil-saving dam devised many years ago by J. A. Adams, a Missouri farmer, recently has come into extensive use for filling large gullies. The dam is of earth and the water is carried under it through a drainpipe of tile or galvanized iron. Some yards above the dam this drain connects with a vertical pipe, known as the "drop inlet," which is open at the top. The dam stops the flow of water until the latter rises to the top of the inlet, and the slit deposited in the temporary pond thus formed fills the gully at a rapid rate.

THOUGH, as we have just seen, much is now known about methods of checking erosion, much research work remains to be done at the new stations mentioned at the beginning of this article. At these places crops of various kinds will be grown on experimental plots having different angles of slope and containing soils of different types. Adjacent tanks will collect the runoff water, so that comparative measurements of the amount of eroded material can be made after each shower. All existing methods of protection will be tested and probably others will be developed.

One possibility now in view is the chemical treatment of soils to make them more pervious to water and thus less subject to removal by washing. Many local problems must be worked out, since the conditions affecting erosion vary considerably from one part of the country to another.

The greatest need, however, is popular education concerning this terrific scourge of agriculture. As recently as two years ago, it was stated, on the best authority, that in many parts of the United States where erosion is severe the majority of farmers had never seen a terrace, and many had never heard of this valuable means of conserving the soil.

AMERICA TO SAVE KING OF HORSES

(Continued from page 25)

quent formation of the famous Davenport stud of pure Arabs.

As a matter of fact, the Arabian horse is the original source from which all modern light horses throughout the world derive most of their beauty and virtues. Experts who have traced the ancestry of the thoroughbred race horses of today have found that all of them descend from only three Eastern horses imported into England in the beginning of the eighteenth century. These were the so-called Darley Arabian, the Godolphin Arabian, and the Byerly Turk. The blood of the two Arabs, especially that of the Darley horse, was the most highly prized.

BY a process of elimination in breeding, the strain of the Darley Arabian has become paramount. Statisticians have calculated that of all the winners in the "classic" English races—the Derby, the Oaks, and the St. Leger—since these events were established about 125 years ago, approximately ninety-five percent were descendants in the male line from the Darley Arabian.

This superb animal was brought to England about 1705, during the reign of Queen Anne. It derived its name from the fact that it was discovered by an English commission agent and sportsman named Darley, who lived at Aleppo, Turkey. While on a hunting trip, Darley met an Arab riding a very remarkable horse, whose speed, endurance, and lightness gave it the appearance of a faultless animal. In exchange for an English musket, then a rarity in those parts, and a considerable sum of money, Manicka, as the horse was called originally, became the property of Darley, who sent it to his brother in England.

There are but five distinct families of pure Arab horses in the desert, known collectively as *Al Khamsah,* "the five." The family names are *Kehilan, Seglawi, Abeyan, Hamadani,* and *Hadban.* Apart from these patricians and a certain other class which has found some slight favor among the Bedouins, the rest of desert steeds are *Kadish,* or mongrels, and are contemptuously referred to as "sons and daughters of horses." Those Bedouins who still breed pure Arabs are extremely jealous of their animals. They hardly ever part with the genuine blood, and do not even want to show their outstanding animals to strangers.

REAL pedigrees are unknown in the desert, H. K. Bush-Brown, former secretary of the Arabian Horse Club of America, told me, and a simple statement of the family or strain of the sire and dam is considered sufficient. The facts of an animal's breeding are so well known to the tribe that deception is virtually impossible. Besides, national honor, religion, and sentiment have trained the Arab to be honest in maintaining purity of breed.

Fifty percent of pure Arabs are bays, thirty percent grays, and the rest have shades of chestnut and brown. Whites and blacks are rarely encountered; duns, piebalds, and yellows are never found. This official statement in the Arabian Stud Book disposes of the general belief that Arabs may be identified by color.

How, then, can they be recognized? The true Arabian is a thing of beauty and once seen, even by the layman, never again can be confused with the spurious. The pure steed is small but possessed of slender limbs of steel, magnificently arched neck and tail, dished or concave face, and large soft eyes.

This mag- *(Continued on page 149)*

AMERICA TO SAVE KING OF HORSES

(Continued from page 148)

nificent animal is not the product of careful breeding alone. According to Professor William Ridgeway, of Cambridge University, England, Nature endowed the so-called Arab with many of its finest qualities before domestication by man, and the Arabs have improved the breed without greatly modifying it. In fact, Professor Ridgeway has traced the origin of the "Arabian" horse to Libya, west of Egypt, and to a period dating back from 1600 to 2000 B.C.

THESE findings have been pronounced sound by as high an authority as Professor Henry Fairfield Osborn, leading American evolutionist and president of the American Museum of Natural History, New York. But whatever the place of its origin, says Professor Osborn, the animal's outstanding characteristics were established long before domestication. These features, therefore, are of such antiquity as to be extremely stable in heredity and cross breeding.

The most important of the Arab's hereditary characteristics, according to Professor Osborn, are found in the animal's skeleton. Its backbone has one vertebra less than that of other horses. In the foreleg the ulna, or small bone, is complete, whereas in other horses it ends in a splint. It has only sixteen vertebrae in the tail, as compared to eighteen in the tail of horses from northern Europe. Other peculiarities are the horizontal position of the pelvis, the bony structure of the hips, a characteristic of most animals of great speed; the large size of the brain case; the relative shortness of the skull; and the slender shape of the lower jaw.

What the Arabs did was to ennoble the breed by never permitting the mating of individuals that were not of the greatest beauty and finest quality. As for the horse's unusually gentle and tractable disposition, this is mostly due to Arab breeding. Only the Bedouin and nomadic life could have produced a horse of this temperament. In the desert the horse is bred and reared in closest contact with man. Master and horse live in mutual interdependence; the Bedouin's very life is bound up in his mount. No wonder, then, that the greatest care is exercised in training it.

Violence is never used. If a horse needs to be corrected, it is done with soft words and remonstrance. So, naturally, as generation succeeded generation, the horse, never having felt whip, stick, or spurs, came to place implicit confidence in man and became affectionate and familiar.

THESE traits are observable even in foals from the day they are born, indicating that qualities originally the result of training and environment now are being passed down as a blood heritage. Despite the close and intensive breeding which must have tontinued for centuries to maintain the five *asil* strains, one never encounters those exhibitions of temper and high tension so often found in our thoroughbreds.

As a consequence, colts and fillies never have to be broken. They are born tractable and take naturally to the saddle. They are ridden by children of the tribes when only a year or two old.

They still talk about the precocious antics of "Pep," born three years ago on the Kellogg ranch. Pep, of pure Arabian blood and derived on one side from the Davenport line, now takes pride in performing forty-seven tricks, but the colt itself devised its first stunts.

(Continued on page 150)

AMERICA TO SAVE KING OF HORSES

(Continued from page 149)

One day, when only a few months old, the youngster poked its soft muzzle against its groom as though begging a caress. Suddenly, with a flip of its jaws, it whisked a handkerchief from his pocket, gamboled about with it for a few moments, and then returned it. The next day it was a hat the colt snatched off, which it pushed about the ground like a cat playing with a mouse before returning it to its owner.

Shortly after that, Pep improved upon its clowning by playing hide-and-seek. The animal's playfulness increased with the weeks and months. Very early, it showed keen delight in pushing a ball around the grounds; in opening boxes, taking things out of them, putting them back, and closing the boxes again; in conquering the mysteries of a teetering seesaw; and in mounting a precarious perch atop a pedestal. These, however, were mere "amateur" efforts. Now there is a finesse in Pep's performances, contributed by a trainer especially employed to develop its natural abilities to the utmost.

IF it doesn't watch its step, though, the three-year-old will be outdistanced by a precocious filly that recently was born on the Kellogg Ranch and almost immediately won the admiration of attendants and visitors. The ranch, by the way, has become a Mecca for horse lovers. During the first six months of this year, more than 50,000 persons came to see the wonderful horses there.

The well-used Arabian is a pet, and stallions are as gentle as mares. The Arab, says William Robinson Brown, the noted breeder, will pick up a piece of clothing its rider has dropped. Picketed by its master's tent, or beside him while he is asleep in the desert, it neighs and awakens him at the approach of strangers and wild animals. In the hot noonday sun it will stand motionless while he sleeps in its shadow. In battle, it will bite and kick at an enemy or an enemy's horse. And if the rider falls in battle, it stands guard over him. There have been instances of a mare guiding a rescue party to its fallen and wounded master, and of carrying him back to his tent when mortally wounded itself.

The famous stallion Khaled once gave an exhibition of fortitude under trying circumstances. As it entered a dark stable its forefoot caught in a round hole left open by the removal of a drain cap. It made one or two vain efforts to extricate its foot, but it was held fast by the edge of the shoe. Most horses would have struggled violently and thrown themselves, with the inevitable breaking of the leg. But Khaled, though trembling, stood perfectly still until its foot was released.

There is a definite reason for the hardihood and endurance of the Arab. These qualities are the direct result of life in the desert, where vegetation is sparse, water sometimes two and three days off, and where forced marches without food or drink are quite common.

THE Arab horse, in the desert, receives only two meals a day beside what grazing it may find. These meals consist of three or four pounds of barley or chopped straw and a handful of beans. The ration of water is scanty, and given only at night. If the water is exhausted, the horse is fed a little camel's milk and a few dates in the morning.

On this kind of fare an Arabian horse, carrying one third of its own weight, or about 300 pounds, has been known to go 310 miles in forty-nine hours through the burning sands of the desert!

BLIND FLYING—A RACE AGAINST DEATH

(Continued from page 39)

out of the corner of my eye, I saw the air speed indicator hand edging steadily ahead. It registered 130 miles an hour when I realized what had happened. In holding the wings level and the ship pointed ahead on the course, I had let the nose drop. We were diving through the fog. I lost nearly a thousand feet of altitude before I got straightened out. If I had been over mountainous country, I might have crashed.

One of the first things a pilot has to learn in training for blind flying is to forget his sensations and trust the instruments. That's not easy, especially for experienced flyers. I have taken up old pilots in "The Blind Robin" and had them swear the instruments were wrong. If you put a ship into a right turn, straighten out, and then ask a passenger, who has kept his eyes shut during the maneuver, what the ship is doing, he will invariably say: "It is still turning to the right." That is what his sensations tell him.

IN giving the blind-flying training, I climb to about 1,500 feet, level off, and reduce the speed of the Robin to eighty or eighty-five miles an hour. Then I tell the student in the blind compartment to steer a straight course by the instruments. He has to keep the speed uniform. This indicates that he is neither ascending nor nosing down. By watching the bank and turn indicator, he must keep the wings level and the nose pointed straight ahead.

When he can steer a straight course, he is taught to climb and descend at an even rate with the wings level. Then he begins making turns. This is hardest. In a correct turn, the hand of the turn indicator swings about a third of the way toward the letter L or R, depending upon the direction of the turn. The ball of the bank indicator is kept stationary between the two vertical lines on the tube.

If the plane is not banked enough, so it skids outward from the center of curvature, the ball moves in from the center lines. If the ship is tipped at too steep an angle, so it side-slips in toward the center of curvature, the ball moves in from the lines. When the ball moves out, the stick needs to be tilted more; when it moves in, the stick needs to be tilted less.

In a correctly-executed maneuver, no matter whether it is a loop or a chandelle, a vertical bank or steep spiral, centrifugal force will hold the ball of the bank indicator steady between the lines at the center of the curved tube.

AS soon as a student has mastered smooth ninety-degree turns in either direction, he attempts complete circles. Then he takes up spirals. The instructor in front tells him what to do and, guided by the instruments, he does it. At this stage, he is ready for a blind cross-country flight. At Curtiss Field it is usually made in this manner:

Directly over the field, the student starts on a compass course for Roosevelt Field, about ten miles away. He watches his air speed, takes into consideration the direction and velocity of the wind, and when he believes he is over Roosevelt he makes a 180-degree turn and heads for home.

The instructor watches for other machines in the air. When the student in the "dark room" thinks he is above Curtiss again he tells the instructor. Once, I had a student shout through the tube: "Here we are—home again!" when we were at least three miles from the field!

On long blind flights, such as are made by mail flyers, other *(Continued on page 152)*

BLIND FLYING—A RACE AGAINST DEATH

(Continued from page 151)

instruments are also used. The radio compass, sending out a series of signals to show the pilot when he is getting off his course, helps lead him through the fog. On special flights, notably Captain Arthur Page's recent blind Omaha-Washington, D. C., journey, a visual radio compass takes the place of the ordinary one. The constant beating against the ears of the ordinary audible signals deafens a pilot on a long flight. Sometimes mail flyers have to remove their headphones for five or ten minutes at a time to rest their ears.

With modern apparatus, a capable pilot has little trouble flying blind. But landing "blind" is another matter. Under special conditions at a familiar field this was accomplished by "Jimmy" Doolittle, one of the best pilots in the world, during the Guggenheim fog tests, a year ago. At present, no pilot attempts it if he has a parachute. When mail flyers run out of fuel in a fog they kiss their ships good-by and take to their parachutes.

THAT is what Jack Webster, an N. A. T. pilot, did last year after a hair-raising experience with fog over the Atlantic. He was bringing a Douglas mail plane from Cleveland to Hadley Field, N. J. Fog closed in east of the Alleghenies. He flew right over Hadley Field without knowing it. He kept on, looking for a hole in the fog through which to come down. Then he "smelled the sea."

Plunging through the fog, he leveled off under its low ceiling. As far as he could see the gray water of the Atlantic was tossing in the murky light. His compass was spinning and useless. He climbed above the fog again and headed in the direction he thought was northwest. After what seemed like hours, the engine coughed and stopped. The fuel tanks were dry.

Without any idea whether he would come down on land or sea, Webster plunged overboard and pulled the rip cord of his parachute. Dropping out of the thick fog, he landed in a garden near a river in Connecticut. The plane crashed on the other side of the stream. He said afterwards if he had come down in the river he probably would have curled up his toes and drowned peaceably, thinking he was in the middle of the Atlantic.

Another N. A. T. pilot once circled over Connecticut for two hours looking for a hole in the fog. The fuel gave out. Just as he threw his leg over the side of the cockpit to jump, a hole opened in the fog below. With a dead stick he dove through and landed in a cornfield.

SOMETIMES a flyer who is caught over a fog bank that is being blown in from the sea can save himself by racing downwind to overtake the front edge of the advancing vapor. Above the fog, a pilot has no way of telling how thick it is. It may extend clear to the ground or it may stop with a ceiling hundreds of feet in the air.

A pilot who is caught in fog with passengers, so he cannot jump with his parachute, and runs out of fuel, has only one chance of escape. That is to come down at the lowest possible gliding speed and trust to luck that he can avoid large obstacles at the last moment. If the ship strikes underbrush or saplings, the crack-up will not be serious.

Private pilots have little occasion to fly in fog. They should always obey the rule: *follow the ceiling down.* This means that when the bottom of the fog or clouds, known to pilots as the *(Continued on page 153)*

BLIND FLYING—A RACE AGAINST DEATH

(Continued from page 152)

"ceiling," lowers, the flyer should bring his ship down to keep below it. He should never fly above fog. It may close in and trap him. If he keeps below the ceiling and fog closes in, he can land before visibility is lost.

In thick weather, it is always better to "go around the block" than to take short cuts. Always follow some easily-seen landmark when visibility is poor. For instance, when the weather is bad, I avoid the short cut across the Alleghenies in flying to Long Island from the west. I go around by Albany, following the easily-seen New York State Canal, and then fly down the Hudson River. Most pilots do the same.

GOING into Chicago in thick weather, I usually come down and "ride" the four-track Michigan Central Railroad right-of-way into the city. Near the landing point, it is always unwise to fly by compass out of sight of the ground. If you are under the ceiling, you know what the landing conditions are like at all times. If you are above the clouds, the ceiling may drop clear to the ground and you won't know it until you crash into the fog-hidden earth.

But fog isn't the only weather condition that makes blind flying necessary. A deluge of rain during a squall or a thick flurry of snow will "put out a pilot's eyes" as effectively as fog.

Last February, I had to fly through a blizzard, using the wind as a compass. I was taking four New York business men to Bristol, Pennsylvania, to demonstrate a new Loening-Keystone amphibian. We hopped off from Roosevelt Field in a big blue Travel Air monoplane with a 300-horsepower Wright whirlwind engine.

The weather reports predicted snow, but the ceiling was high so we took off. Over Staten Island, we ran into heavy clouds. We dove down through them. The ceiling kept dropping lower and lower and we dropped with it. Near Trenton, N. J., we were only a couple of hundred feet in the air. Then it began to snow. The air was filled with blinding, swirling flakes that struck the windshield of the cabin at a hundred miles an hour.

At first I thought it was only a local flurry. But the snow grew thicker. In a blizzard like that, the only direction you can see is straight down. Flying by the instruments, I turned back. Then I remembered the compass was not set at the start of the flight. The distance from Roosevelt Field to Bristol is only about 100 miles. So I had not set the instruments before the take-off. Following its course might land us over the Atlantic. On the way out we had battled into the teeth of the wind all the way. If I turned back with the wind blowing directly from the rear, I knew I would be on a straight line for home.

BY shooting glances at the blurred ground below, after I had swung about, I checked up on the side drift of the ship as it was carried by the wind striking it at an angle from the rear. When the drifting stopped, I knew I was flying with the wind on my tail and was headed for home.

We came out of the snow near New York Harbor. But the ceiling was so low that the torch of the Statue of Liberty was half hidden in the scudding clouds as we raced by for a safe landing at Roosevelt Field.

Practice in blind flying is insurance against the unexpected. The average pilot will not fly by instruments regularly. He will need the ability to fly blind only on rare occasions, in sudden emergencies. But when he does need it, he needs it badly.

I STUDIED THE BIRDS TO LEARN TO FLY

(Continued from page 57)

him would do likewise at the same instant.

Often I have seen pelicans soar in a perfect calm for miles just above the waves. I was puzzled for a long time as to how this was accomplished. Then it occurred to me that the effect of a wave of water moving through still air would be the same as that of a breeze blowing against the side of a ridge the same size as the wave. In both cases, the air would be deflected upward, causing a rising current upon which a bird could soar.

Almost any calm morning, you can find pelicans soaring in formation along the waves on the rising air above their crests. The instant the wave starts to break, the pelican will hop to the next wave farther out and ride the up-currents above it. They will fly for miles thus without moving a wing.

ON several occasions I have seen pelicans flying at altitudes as high as 1,500 feet. One day, I was flying along the coast in an airplane when I sighted a dozen of them soaring together in wide circles at an altitude of more than 1,000 feet. I decided to go over and see what the air was like at the place where they were flying. When I maneuvered under the birds, I found a strong rising current which the plane struck with a sharp bump.

It is interesting to watch gulls and pelicans when they are flying along the coast looking for fish. The best way to do this is through a pair of binoculars. You can even see the look in the bird's eye as he flies along. You can tell that it gives no more thought to its flying than a man does to the way he walks.

Through slow motion pictures, I have observed closely that a pelican has one feather at each wing tip that acts as an aileron to preserve lateral, or sidewise, balance. I have been told that if this feather is pulled out, the bird can never fly again. However, from my observations, I believe that the pelican could adapt one of the other wing-tip feathers to take the place of the one which was lost. All soaring birds, my moving picture films show, keep sidewise balance with the two or three outermost feathers of their wings.

Near the bird's body, the leading edge of the wing is formed by the muscles that pull the wing in when it is folded up and hold the leading edge stiff when the bird is flying with full wing spread. The curve of a soaring bird's wing gradually diminishes from a deep, thick airfoil near the body to a flat plane at the tips.

BESIDES using the "aileron feathers" to control its flight, the bird frequently expands and contracts its tail and often puts it into the form of a "V" or an inverted "V," as seen from the rear, to aid in maneuvering.

Fore and aft stability is largely maintained by shifting the position of the head. The head of a bird seems to have a great deal of weight in proportion to the rest of the body. Motion pictures of birds in flight show that they thrust their heads out and pull them in continually as they fly, shifting the center of gravity to maintain balance.

When a bird lands, it almost always pulls its head back to throw the center of gravity further aft, making it a little tail-heavy. I have watched pelicans for hours when they were landing and taking off at their feeding grounds. When they come in for a landing, their feet are held up, out of sight, until the last second. Then they are swung down like a pair of pedals to support the bird slightly as it touches the water. The landing is made gracefully and *(Continued on page 155)*

I STUDIED THE BIRDS TO LEARN TO FLY

(Continued from page 154)

the pelican never folds its wings until it is certain that all forward motion has stopped.

I have never seen a bird take off or land without heading directly into the wind, just as an airplane or a soaring ship does. On the take-off, a pelican will always give several sharp strokes with its webbed feet to gain the forward propulsion necessary to rise to the top of the water before beginning to use its wings for power.

Young birds have to learn to make good landings just as do fledgeling students at flying schools. One of the funniest sights I ever saw in watching soaring birds was when a young pelican tried to land on a telephone pole in a strong wind. The pole had been cut off square at the top and the bird thought it would be a grand place to practice landings.

IT came in full of confidence, misjudged the strength of the wind, overshot the post, and "sat down" in the air beyond. It looked surprised and circled for another try. This time, just as it was sticking out its feet, a gust struck it and it undershot the mark.

As it went around again, I could imagine it saying to itself that it would sit down on that post if it took all summer. It maneuvered carefully this time and plumped down square on the flat top of the post. Then it folded up its wings, stuck out its chest, and looked very satisfied with itself.

If I am interested in watching birds, they are just as interested in watching me when I am soaring off Point Loma. I have had gulls and pelicans trail along beside me for fifteen minutes at a time, curiously eyeing my great white bird.

When I was setting the six-hour-nineteen-minute official American record last January, I noticed a pelican flying directly under me close to the water. It seemed worried about the big bird overhead. Finally, it climbed up to investigate. It maneuvered gracefully alongside and flew not more than twenty feet from my face, constantly watching every move I made as we flew along together. It would make a graceful turn ahead of me and I would follow as though we were flying in formation.

For more than ten minutes, we circled about in this manner. Then I decided to see what would happen if I gave a sudden shout. I maneuvered the sailplane to within fifteen feet of the pelican, then let out a hair-raising yell. The bird closed its wings and dropped like a bullet toward the ground and disappeared.

On some of my record-making flights, I have been able to discover the location of the strongest currents by watching the birds soaring along Point Loma in the rising air. The manner in which these feathered soarers maneuver to get the most from up-drafts has taught me lessons that later aided me in piloting my lightweight sailplanes.

IN designing these ships, I patterned them after the birds in four respects. First, by using large controlling surfaces that can move through wide angles, I attained ease in maneuvering and controlling. Second, by deep, thickset wings, without external bracing, I cut down the weight so the planes can fly at low speeds. Third, by making the design streamlined and birdlike, I cut down resistance. Fourth, by incorporating folding, or demountable, features, I allowed the machines to be transported easily and stored in small spaces.

Both in designing and flying soaring planes, the teachers that can instruct us most are the birds. These leaders are masters of an art which we are just beginning to learn.

AVOID FADS, PLAN FOR THE FUTURE

(Continued from page 73)

from front to rear, solving all drainage problems.

In the rear is a one-car garage of frame construction in keeping, as regards style, with the architecture of the house. The garage contains in addition to car space a servant's room with complete toilet facilities and a small porch. The two-car garage is gaining in popularity but is, in my opinion, a matter for individual decision. On a small lot with a medium size house, a two-car garage containing servants' quarters which in such a case would almost necessitate two stories, would be prone to rival the house in size and distinctly choke the lot.

I SHOULD say that, unless the servants' quarters were located in the house and unless one actually had a definite need for two-car space, the one-car garage is preferable when it contains the servants' rooms. However, this would, of course, be determined by one's needs. In the south, the servants' quarters are, in small menages, almost always combined with the garage.

No matter how beautiful or architecturally correct the exterior effect may be, the family cannot be at home on the outside. With this thought in my mind, I strove particularly for convenience and beauty on the interior. I guarded against innovations that were too radical, fearing to institute something of which my family would soon tire.

There has been a tendency in recent years toward extreme effects in new houses. These have been, I should say, interesting but unenduring. In this part of the country, we feel the Spanish influence in building to a larger degree, possibly, than any other. This type of architecture lends itself easily to extremes. I have seen pink plaster interiors literally honeycombed with twisted Spanish columns in every conceivable location, and enough arched doorways and windows to make one dizzy. Undoubtedly, such effects attract the attention and provide a novelty.

I believe, however, that such architecture is short-lived on the basis that only the simple and chaste can be endured indefinitely. A rich, heavy diet will inevitably result in physical or mental indigestion.

A PRACTICAL and workaday reason for embodying simplicity in my house was that I believed that its resale value would not be enhanced by employing unusual or striking effects which might be the vogue today and decidedly out of fashion tomorrow.

The interior, then, is plastered on wood and the lounge, dining room, kitchen, stair hall, and baths have sand finish—a color that is restful and adaptable to any decoration scheme.

All floors in the house are oak. The front door entering into the stair hall is of wide board construction with "V" joints, the square leaded glass being high up in the panel; the doors are master keyed—that is, one key answering both for the front and rear entrances. The electric switches are the tumbler type. The door knobs are glass throughout. The wood trim for all interiors is narrow with a molded back band; the base is three-membered and is only four inches high.

On the first floor, the elliptical arches from the lounge to the dining room and to the hall give a spacious air without overdoing an effect which is, at this time, often used.

One feature that I consider successful is the inclosed stairway that starts out of the lounge through an arch corresponding to the adjacent arched door to the dining room. The stairway, without balustrade, has a round handrail on the right side going up, suspended from the wall by wrought iron brackets. The stair lands near the bedroom and bath doors. I consider this type with its spiral steps at the first floor more ornamental than the conventional stair with the usual level platform.

The kitchen arrangement is ample, the room being thirteen feet wide by ten feet deep, and offers the additional conveniences of built-in sink, adjacent cabinet, rear entry providing refrigerator space, immediate access to the dinette, which is nine feet wide by eight feet deep, and easy access from any other room on the first floor.

THE dining room I made purposely small, because in these days of dining away from home and of utilizing the dinette for meals other than breakfast, I considered that the space might be employed to better advantage than in a room used less often than certain others. I was enabled by this means to provide a large lounge and still maintain a somewhat modest floor plan.

For the bedroom walls I varied my plan by using paper instead of plaster. It has always been my opinion that plaster, although ideal for more formal rooms, did not afford the intimate coziness desirable in the bedrooms. By using paper particularly adapted to the Colonial style of the house, I achieved the effect of warmth and relaxation for which I aimed.

The second floor rooms are not full height. Some of the roof pit shows, and the space between the walls of the bedroom and the roof have been made into three large closets. The dormers and the double windows on the west wall heighten the effect of coziness.

The upstairs bath, with two casements, has plenty of ventilation. I installed only a shower there with a recepter on the floor in place of the usual tile floor; the bath downstairs containing a tub. Both rooms have tile bases and wainscoting of plaster finished in tile effect.

In this part of the country, in small houses particularly, basements being the exception rather than the rule, heating is done almost in every case by gas stoves, logs, or imitation coals. The lounge contains a Colonial style mantel with marble facing. Into this, the stove is placed. In every room there is a gas connection for a stove.

Using these plans, I believe that a satisfactory small home may be built for a moderate sum of money and yet embody every needed convenience and bit of beauty.

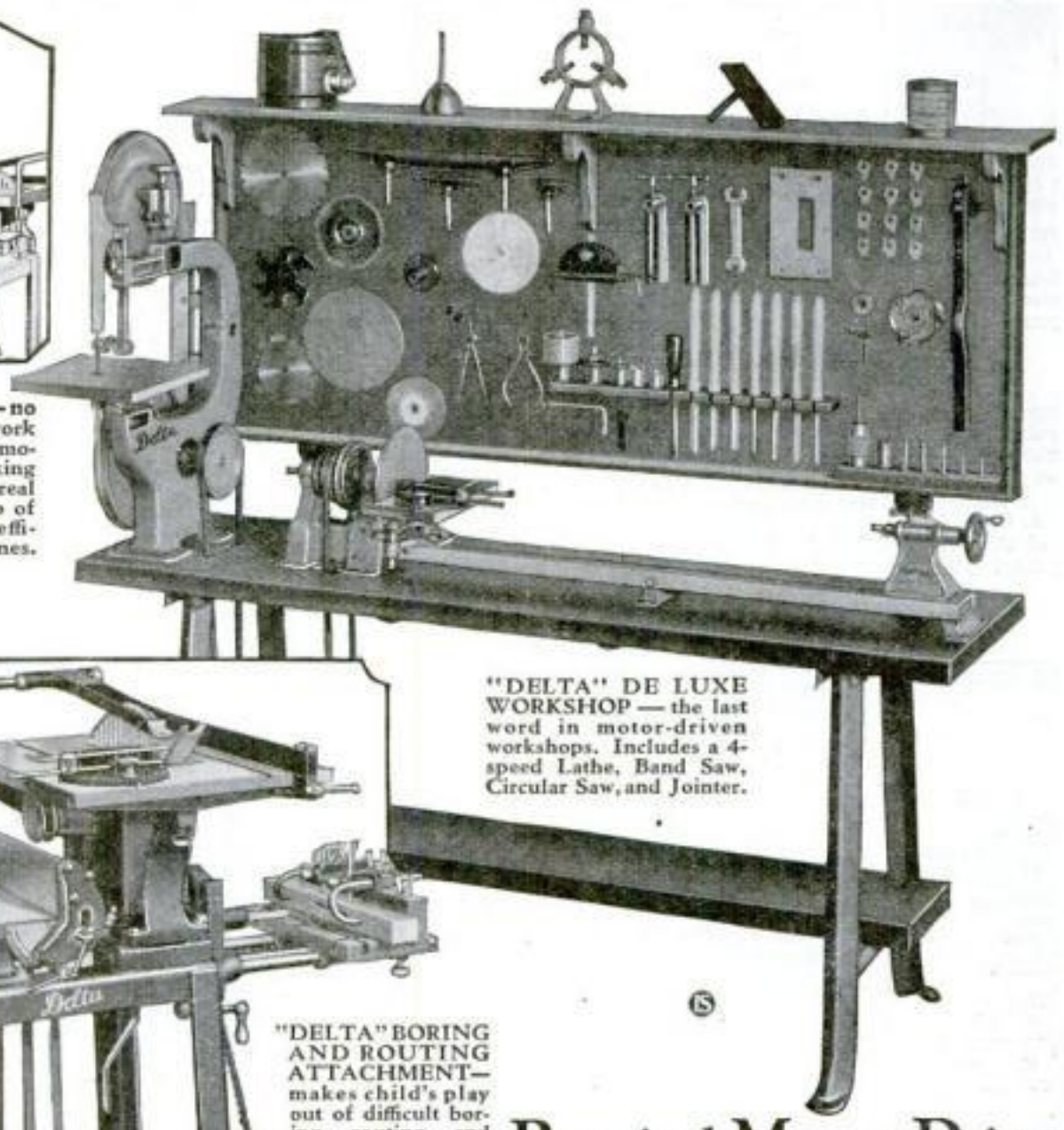
COW WORKS HARDER FOR FARMER THAN HORSE

DAIRY cows work harder for farmers than horses. So concludes Dr. W. L. Gaines, of the University of Illinois Experiment Station, who has found a way of comparing the "horsepower" of each. His way of figuring takes into account the heat value in the milk and butterfat.

The average dairy cow, Dr. Gaines calculates, produces in a year 175 pounds of butterfat and 4,800 pounds of milk. The energy that these products contain exceeds by 82.4 percent that supplied by the work of an average farm horse in the same length of time.

New Units, New Features, New Improvements in Complete 1931 "Delta" Woodworking Line

No more drudgery — no more tedious hand work when you use "Delta" motor-driven tools. Working with wood becomes a real pleasure with the help of these time-saving, efficient, practical machines.



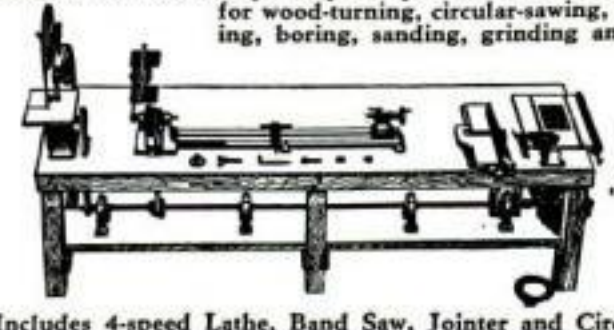
"DELTA" DE LUXE WORKSHOP — the last word in motor-driven workshops. Includes a 4-speed Lathe, Band Saw, Circular Saw, and Jointer.

"DELTA" BAND SAW has many exclusive features. Provided with special extra-safe guard. Furnished with or without stand.

"DELTA" BORING AND ROUTING ATTACHMENT — makes child's play out of difficult boring, routing, and mortising. Convenient, easy to operate. Furnished separately if desired.

"DELTA" COMBINATION JOINTER and CIRCULAR SAW. Can be operated separately or together—no interference. Furnished with or without motor.

"DELTA" HANDI-SHOP — A complete, compact, practical motor-driven workshop. Popular priced. Includes equipment for wood-turning, circular-sawing, scroll-sawing, boring, sanding, grinding and buffing.



"DELTA" LINE-SHAFT SHOP

Includes 4-speed Lathe, Band Saw, Jointer and Circular Saw. Operates with either gasoline or electric motor. Very efficient.

Practical Motor-Driven Woodworking Equipment Now Within Reach of All

Again "Delta" blazes the trail toward woodworking efficiency with the announcement of its new 1931 line! Now are available at astonishingly low price levels a complete series of compact, rugged woodworking machines incorporating numerous exclusive constructional features. Each unit embodies the practical, efficient design, the careful workmanship, the dependable quality of materials — for which the "Delta" trademark stands. The new "Delta" Boring and Routing Machine, the "De Luxe" Workshop, the new "Delta" Band Saw, as well as the improved "Handi-Shop" are but a few of the Delta Units that will be of intense interest to all those who work with wood. All units now operate with either electric or gasoline motor power.

Make Things Quickly and Easily With These Modern Motor-Driven Tools

They save time and labor, and produce better work for artisans, farmers and mechanics. Up-to-date craftsmen everywhere are flocking to motor-driven woodworking equipment to eliminate tedious hand labor. And for full or spare-time work, "Delta" Units quickly pay for themselves.

10-Day Trial EASY TERMS

Send coupon today for free illustrated literature describing the new 1931 "Delta" line. Also details of 10-Day Trial Offer and Easy Payment Plan.

DELTA SPECIALTY COMPANY
Division of DELTA MFG. CO.
1661-67 Holton Street Dept. B1130
MILWAUKEE, WISCONSIN

Delta Specialty Co., 1661-7 Holton Street
Milwaukee, Wis., Dept. B 1130

Gentlemen: Please send me FREE illustrated literature describing 1931 "Delta" line and details of 10-day Trial Offer and Easy Payment Plan. (Check items of particular interest.)

- ☐ "De Luxe" Shop
- ☐ Handi-Shop
- ☐ Band Saw
- ☐ Line-Shaft Shop
- ☐ Routing Machine
- ☐ Jointer
- ☐ Circular Saw
- ☐ Moulding Cutter

*Name*_____

*Address*_____

_____ *Age*_____

Ⓢ This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

WEATHER MAN MAKES THE AIR SAFE

(Continued from page 55)

The Congressional appropriation of $1,400,000 for the maintenance and expansion of the aviation service of the Weather Bureau, which forms part of the Department of Agriculture, is not the only money spent in this important work. The cost of the communication system of the airways is defrayed by the Department of Commerce, and the Army and Navy air services also contribute to the task of making the air safe for the aviator. All in all, the whole official organization devoted to practical work in aeronautical meteorology now is costing the United States Government in excess of a million and a half a year.

EXPENDITURE of this vast sum appears to be amply justified for two reasons. First of all, the extended service immeasurably increases the safety of the highways of the air. Secondly, the more frequent weather reports and forecasts have proved a valuable aid in many walks of life for which they were not originally intended.

To realize fully what the new service has done and is doing for aviation it is necessary to recall the nature and extent of Weather Bureau activities before the country became air-minded.

Until about three years ago, the Bureau, for many years, adhered to the simple plan of collecting, chiefly by telegraph, weather reports twice a day from a rather sparse network of stations, about 200 for the entire country. Observations were taken simultaneously at all stations at eight o'clock in the morning and eight o'clock at night.

These observations were entered on a chart and from the picture of existing weather thus obtained, predictions of weather changes were made in accordance with certain established principles relating to the movements and habits of the weather. Occasionally, when severe storms developed, "special" observations were taken and reported at other hours, and warnings were issued accordingly, but the ordinary reports and forecasts were made only twice daily. Under normal conditions the forecasts were phrased in quite general terms and applied to comparatively large areas, without much attempt at localization.

This system, which still forms the basis of the Weather Bureau's routine activities, was, of course, wholly inadequate for the needs of aviation. When flying began to come into its own, aviators demanded a vastly more elaborate service of weather information than ever before had been contemplated for any purpose.

THE flyer, traveling enormous distances at unprecedented speed, thousands of feet up in the air, is little interested in the weather outlook of the next day or two for extensive areas on the ground. What he needs to know is that of the next hour or two for the particular strip of territory in which he expects to make his flight, and what conditions are at high levels as well as at the earth's surface.

When the demands for an airway weather service were first formulated, meteorologists shook their heads. The cost of the proposed service appeared to be prohibitive. An immense increase would be required in the number of weather-reporting stations, with a corresponding increase in salaried personnel. Reports would need to be made, maps drawn, and forecasts issued at short intervals throughout the day and night, instead of only twice every twenty-four hours. Telegraph tolls, already a huge item in the Weather Bureau budget, would grow to fantastic proportions. The project seemed to everyone to be wildly impracticable.

But experience had shown that it could be done because it had to be done. And while the service is costing a good deal of money, the expense is not as great as was anticipated. Far-flung airway weather service, soon to be nation-wide, is now functioning simply because it is essential to the safe and efficient operation not merely of today's thousands of aircraft, but of tomorrow's hundred thousand.

Thousands of taxpayers who do not fly, and never expect to, contribute to the $1,500,000 the service costs in a year. What good will it do these people who seem uninterested in flying weather?

WITH some slight amplifications and modifications, it may be made extremely valuable for a variety of purposes apart from aviation. As a matter fact, even in their present form, the three-hour bulletins have found a number of uses that were not foreseen when the service was started. The first unit of the airway weather service was established in California in the summer of 1928. Soon after it began to work, the Automobile Club of Southern California arranged to receive the bulletins prepared for aviators and to use them for the guidance of motorists planning trips in the territory covered by the service. And recently the American Automobile Association installed a teletype, connected with a Weather Bureau circuit, at its Washington headquarters for the same purpose and now motorists, interested in rain or shine, can get accurate information as to just what kind of weather to expect during their projected trip.

In California the Weather Bureau itself uses the frequent reports in predicting the occasional rains of the dry season which, if unannounced, would ruin millions of dollars' worth of fruit during the process of sun-drying. The reports also have proved valuable to the "fire-weather" service in the western forests, as fire fighters now can be given prompt notice of coming shifts of the wind and other weather changes affecting the progress of a fire. This information is of great use to them in laying their plans to defeat the flames.

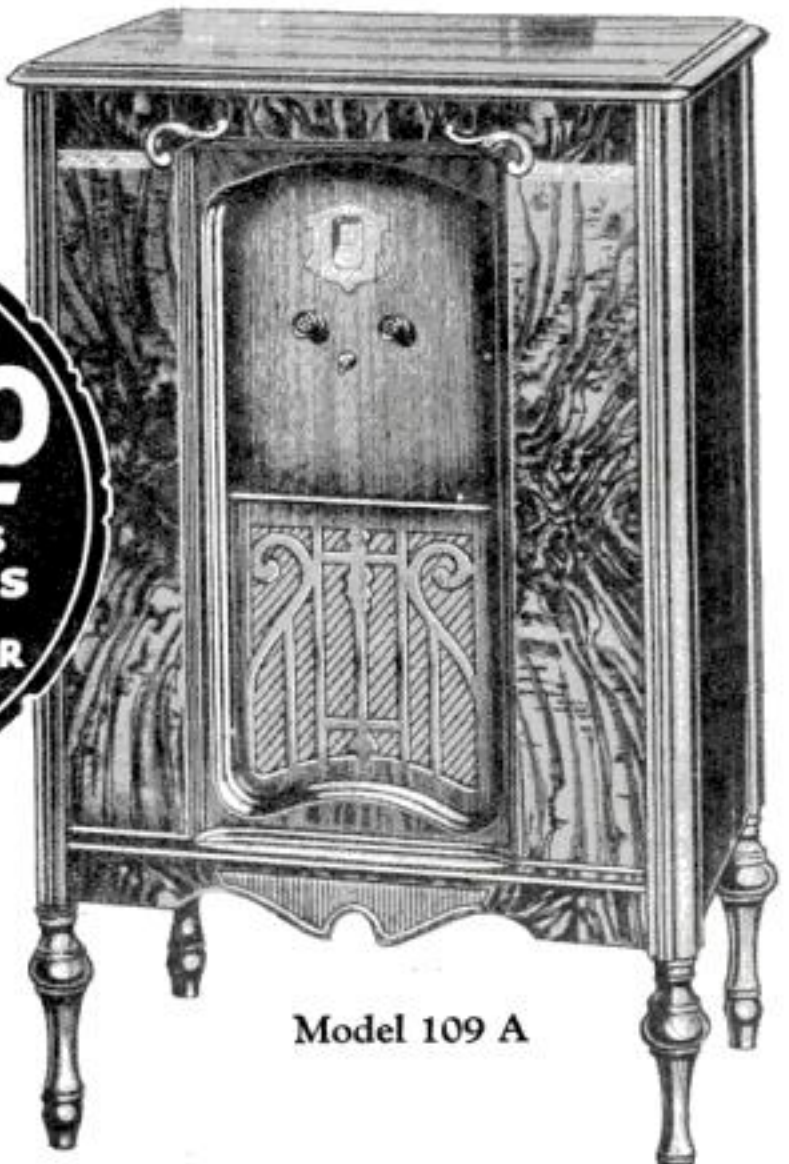
IT is not possible to foresee all the future developments and applications of the new system, but they are certain to be manifold. Forecasts based on an eight A.M. weather map have, in the past, often failed to give notice of important weather events in the afternoon, notably the summer showers that interfere with so many outdoor occupations and amusements. Heavy snowfall is especially difficult to predict many hours in advance. Even if they should do nothing else, the short-term weather reports will make forecasts more nearly accurate and more definite and will eliminate the words "probably" and "possibly" from the weather man's vocabulary, thus giving the general public far greater confidence in the reports.

Certainly something spectacular has happened in the field of practical meteorology! About two years ago, the Weather Bureau set out to organize a special information service for a relatively small industry. Today it has on its hands the most elaborate weather forecasting organization the world has ever seen, and one which is applicable to a great variety of human needs and whose value probably will increase very rapidly in the future.

A Sweeping CHALLENGE to 1930 RADIO BUYERS

We Challenge YOU To Match This Radio Elsewhere UNDER $140!

Only $67.00 LESS TUBES
SLIGHTLY HIGHER IN SOME STATES



Model 109 A

YES! One of our most popular radio values! Saves you up to $75 at the very least! Performance the equal of any $140 radio made! It's one of the very latest type Triple Screen Grid ALL-ELECTRIC Console Receivers—and is priced to you for *just about half what you'd pay for similar quality elsewhere!*

Scores of Similar Values in Our New 1930-31 Radio Book

Send today for our FREE Book of Radio Bargains describing scores of values like this! We positively guarantee savings as high as $100.00 on some models! WE CHALLENGE you to find better values *anywhere!* WE CHALLENGE you to test any of our radios side by side with any other made at DOUBLE our low prices! WE CHALLENGE you to compare their mellow tone; their handsome cabinets, with any others you've ever seen. WE CHALLENGE you to find better values for the money!

TRIPLE SCREEN GRID (7 Tubes)

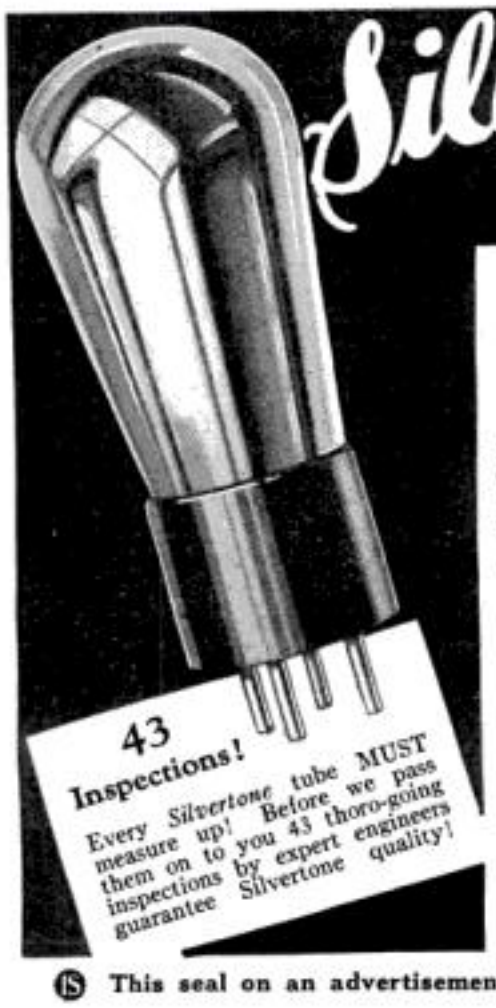
Beautiful Walnut Veneer Cabinet!

Think if it! Four fully tuned stages, using three new type ALL-ELECTRIC SCREEN GRID tubes. Double shielded radio frequency coils. Push-pull amplification using two type 245 power tubes. High and low voltage taps. Two antenna posts. Single illuminated dial. Large substantial power pack. Super dynamic speaker. Cabinet worthy of the finest homes! *Send for our new FREE Book of Radio Bargains! There the whole story is told!*

Free New Book of 1931 Radio Bargains!

Send today! Everything in Radio! Hundreds of bargains! The very latest radio models with all the newest improvements! Accessories, Tubes—and best of all, *new low prices!* Send for this FREE Book which also tells about our *10-Day Trial Plan* and our *Liberal Time Payment Policy*. Mail coupon NOW! No obligation to buy!

Sears, Roebuck and Co., Chicago



Silvertone TUBES

Lead in Life, Quality and Performance!"

Read here what Prof. J. L. Arnold, Head of the Department of Electrical Engineering, New York University, says about *Silvertone Tubes!* After exhaustive comparative tests with five of their leading competitors, he says in part:

—"I find them to have a higher degree of uniformity and a longer life from an inspection of their limits than those tested.
—"Silvertone test limits are closer than the limits found for the others tested.
—"Their average mutual conductance is higher than that of the other makes tested.
—"The average performance constants, in comparison with five other leading makes, indicate that *Silvertone Tubes* afford all-round better performance in the average radio set.
—"As high as 40% of these tubes of other manufacturers show test values outside the test limits for *Silvertone Tubes.*

J. L. ARNOLD,
Head-Dept. Electrical Engineering
New York University

43 Inspections!

Every *Silvertone* tube MUST measure up! Before we pass them on to you 43 thoro-going inspections by expert engineers guarantee Silvertone quality!

Mail for FREE Book

Sears, Roebuck and Co., Chicago

Please send me at once your FREE Book of Radio Bargains which contains hundreds of outstanding radio bargains, and gives full information about your *10-Day Trial Plan* and *Liberal Time Payment Policy*. I fully understand that there is no obligation to buy whatsoever.

P.S. 1130

Name .....

Post Office ..... State .....

Rural Route ..... Box No. .....

Street Address .....

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

IS YOUR CAR A HEAVY DRINKER?

Tested and approved
Contest Board
American Automobile Association

IN HOT WEATHER, you naturally expect to add water to your radiator once in a while. That's no special hardship, for water is cheap and plentiful. But when your car develops a huge thirst in winter, it's probably boiling off valuable anti-freeze as fast as you put it in. You can't control the temperature, but you *can* use an anti-freeze that stays on the job—Eveready Prestone, the ONE-SHOT anti-freeze.

Used by Byrd Antarctic Expedition

With every type of anti-freeze to choose from, the Byrd Antarctic Expedition used Eveready Prestone. They first thought of using kerosene, but decided against it. Fortunately . . . because later, in the unimaginable cold of the South Pole, the kerosene actually froze! Yet Eveready Prestone easily passed the stringent test of Antarctic winter. The Byrd Expedition radioed:

"Eveready Prestone meets all manufacturer's claims . . ."

Constant research by the Union Carbide and Carbon Corporation laboratories has further increased the efficiency of Eveready Prestone. This year it is actually superior to the Eveready Prestone which more than a million motorists used to their complete satisfaction last year. It is now *green* in color, so that you may easily identify it.

Go to your dealer or garage-man, before the rush during the first cold snap. Have him prepare your car for winter, taking the simple precautions necessary to make the cooling-system water-tight.

You can put Eveready Prestone in *today*. It's always in tune with the temperature.

Tune in the Eveready Hour, every Tuesday evening at nine (Eastern standard time) over the N. B. C. network.

NATIONAL CARBON CO., INC.

General Offices: **New York, N. Y.**

Unit of UCC *and Carbon Corporation*
Union Carbide

9 POINTS OF SUPERIORITY

1. Gives complete protection.
2. Does not boil off.
3. Positively will not damage cooling-system.
4. Will not heat up a motor.
5. Circulates freely at the lowest operating temperatures.
6. Will not affect paint, varnish or lacquer finishes.
7. Non-inflammable. 8. Odorless.
9. Economical—one filling lasts all winter.

Luckies Are Always Kind To Your Throat

Lucky Strike, the finest Cigarette you ever smoked, made of the finest tobacco—The Cream of the Crop—"IT'S TOASTED." **Lucky Strike** has an extra, secret heating process. Everyone knows that heat purifies and so 20,679 physicians say that **Luckies** are less irritating to your throat.

"It's toasted"

Your Throat Protection—
against irritation—against cough

There are 18 of these merry little figures. One comes in each tin of **Lucky Strike** Flat Fifties.